



FEDERATION OF NIGERIA

ANNUAL REPORT  
ON THE  
DEPARTMENT OF AGRICULTURE  
(Central)  
FOR THE YEAR 1952-53  
PART II

NINEPENCE NETT



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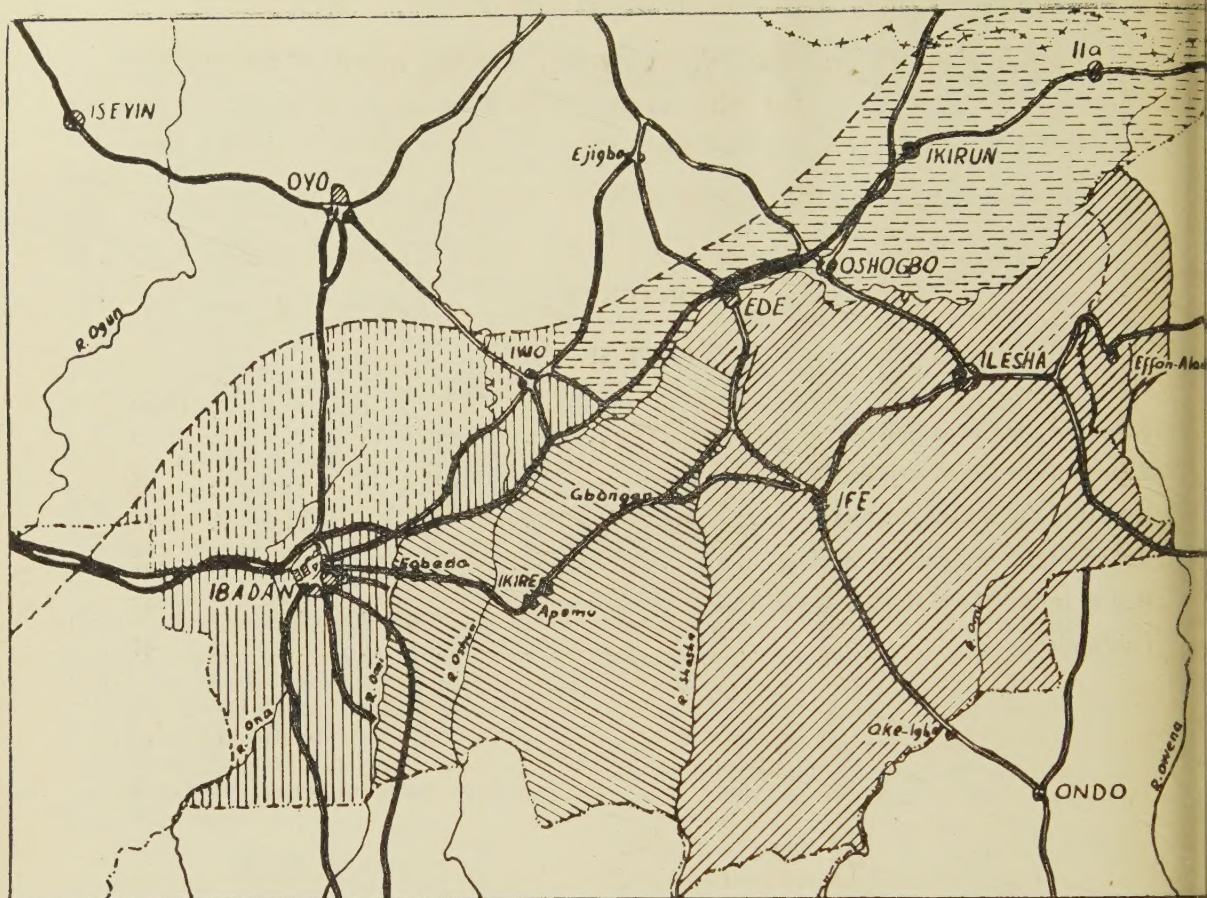
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MAP OF PROGRESS OF THE RECONNAISSANCE SOIL SURVEY  
OF THE COCOA BELT OF IBADAN AND OYO PROVINCES  
MARCH 1953.

- |                                                                                                                         |                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
|  Central Ibadan Section (Completed)   |  Ilesha-Ife Section (Completed) |
|  Central Ibadan Section (Not Started) |  Ikirun Section (Not Started)   |
|  Omi-Shasha Section (Completed)       |                                                                                                                    |
| ----- Approximate Northern Boundary of Cocoa                                                                            | ----- Provincial Boundary                                                                                          |
| ——— Railway                                                                                                             | —+— Boundary between Northern and Western Regions                                                                  |
| ——— Main Roads                                                                                                          | ~~~~~ Rivers                                                                                                       |

0 10 20 30 40 MILES

SCALE IN MILES



# Annual Report on the Agricultural Department (*Central*) for the year 1952-53

## Part II

### COCOA SOIL SURVEY SECTION

#### STAFF

|                  |                                             |
|------------------|---------------------------------------------|
| Dr H. Vine       | <i>Senior Chemist and Officer-in-Charge</i> |
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#### INTRODUCTION

During the year under review there has been a general policy of expansion and training of staff with a continuation of the Reconnaissance Survey and the initiation and completion of numerous relatively small semi-detailed surveys. There have been no important changes in the survey methods but the system of classification has been further elaborated as additional soils were encountered and their relationships understood. The Reconnaissance Survey of an area around Ilesha has been most fruitful in this respect as considerable use was made of information obtained in a recent survey of the area by the Geological Survey Department.

Although the Reconnaissance Surveys remain the fundamental approach to the present system of surveying and classifying the soils, much time has been taken up recently by semi-detailed surveys of small areas for advisory purposes. For example, the policy of the Western Regional Production Development Board is to assist in the development of land after receiving a report on the soils. The rehabilitation work of the Cocoa Division, in areas where cocoa trees infected with Swollen Shoot Disease have been cut out, has also been based on the nature of the soil.

#### SURVEY IN PROGRESS OR COMPLETED

It has been decided to regard the Cocoa Belt of Ibadan and Oyo Provinces as one unit for mapping and reporting purposes and the greater part of this area has now been surveyed. This has been divided into four areas for ease of field organisation :—

- (1) The Omi-Shasha Area ;
- (2) The Ilesha Area ;
- (3) The Central Ibadan Area ;
- (4) The Ikirun Area.

TABLE I

FIELD DATA FOR THE RECONNAISSANCE SURVEY OF IBADAN AND OYO PROVINCES

| <i>Sub-Area</i>        | <i>Remarks</i>               | <i>Area in square miles</i> | <i>Approx. length of traverses in miles</i> | <i>Approx. No. of profiles examined</i> |
|------------------------|------------------------------|-----------------------------|---------------------------------------------|-----------------------------------------|
| Omi-Shasha .. ..       | Completed by 1st April, 1952 | 750                         | 170                                         | 1,360                                   |
| Central Ibadan (South) | Completed by 1st April, 1953 | 460                         | 108                                         | 864                                     |
| Ilesha Area .. ..      | Completed by 1st April, 1953 | 1,600                       | 400                                         | 3,200                                   |
| Central Ibadan (North) | Not started .. ..            | 530                         | 142                                         | 1,136                                   |
| Ikirun .. ..           | Not started .. ..            | 720                         | 182                                         | 1,456                                   |
| Grand Total .. ..      |                              | 4,060                       | 1,002                                       | 8,016                                   |
| Work completed .. ..   |                              | 2,810                       | 678                                         | 5,424                                   |
| To be done .. ..       |                              | 1,250                       | 324                                         | 2,592                                   |

A considerable number of semi-detailed surveys have been carried out and may be grouped as follows :—

- (1) Surveys for the Western Regional Production Development Board ;
- (2) Surveys of the Swollen Shoot Cut-Out Areas ;
- (3) Surveys of Special Areas not included in (1) and (2) ;
- (4) Work in co-operation with the Economic Survey.

#### RECONNAISSANCE SURVEY OF IBADAN AND OYO PROVINCES

*Omi-Shasha Area.*—The survey of this area was completed early in 1952, with the exception of a small amount of checking, in the light of recent knowledge, that is now nearing completion.

*Central Ibadan Area.*—The Field Party based on Ibadan completed that part of the area south of the Lagos-Ife main road late in 1952, and the remainder will be completed by August of this year.

The soils encountered were similar to those mapped in the Omi-Shasha area, but some were derived from the quartz schist ridges which run north and south through the central part of this area. As was first observed and recorded in the Ilesha Area, these tend to be rather mixed with soils derived from sericite schist.

The heterogeneity of the underlying metamorphic rocks (chiefly schist, fine-grained biotite gneiss and coarser gneissose granites) has been most noticeable. The soils derived from these various rocks have distinct field characteristics but where they are intimately mixed recognition is difficult. One aspect of the work has been a study of the relationships and sub-divisions of the soils derived from this group of rocks.

Two new series (Mamu and Lagun) have been named from work in this area and descriptions are given later. It has been most noticeable from the field records that the majority of soils most suitable for cocoa in this area are at present under this crop and that only small scattered areas of a few acres occur which are not so planted.

*Ilesha Area.*—The Party engaged on this survey was based at Ilesha and Ife. The survey consisted of that part of Ibadan and Oyo Provinces South of the River Oshun and East of the River Shasha and a part of the Quartz ridge area around Efon Alaiye in Ondo Province. A geological survey of the area had recently been carried out. After a preliminary investigation of the area, some profitable discussion was had with the Geologist responsible for the field work. It was naturally found that soil boundaries did not exactly coincide with the boundaries of the various rock types recorded by the geological survey. Several new soil series were derived from rocks of the amphibolite complex and the quartz and sericite schists. Descriptions of these are given below.

In this area, a less intensive land-use pattern was found than that occurring around Ibadan. An area of about 200 square miles of soil suitable for cocoa and not at present under this crop was recorded north of the Ilesha-Oshogbo road. A similar (though possibly not so large) area occurs between Ilesha and Ife, and continues southwards. Here patches of cocoa have been planted, but considerably more is possible.

#### CLASSIFICATION OF THE SOILS OF IBADAN AND OYO PROVINCES

The Soil Series previously recognised and described have been further studied and more definitely characterised. The following table gives an outline of the classification (the basis of which was explained in the Annual Report for 1951-52).

##### SCHEME OF CLASSIFICATION (APRIL 1953)

##### *I.—Well Drained Soils*

##### *A.—Skeletal Material :*

##### 1. Ekiti Series

##### 2. Iwaji Series (New Series)



*B.—Residual Mottled Earths :*

- |                    |                             |
|--------------------|-----------------------------|
| 1. Egbeda Series   | 6. Mamu Series (New Series) |
| 2. Olorunda Series | 7. Odeyinka Series          |
| 3. Iwo Series      | 8. Odeomu Series            |
| 4. Ibadan Series   | 9. Shanroji Series          |
| 5. Ife Series      |                             |

*C.—Hill Creep Material :*

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| 1. Asejire Series                 | 6. Okemessi Series (New Series)   |
| 2. Balogun Series                 | 7. Erinoke Series (New Series)    |
| 3. Akure Series                   | 8. Iddo-Irapa Series (New Series) |
| 4. Araromi Series                 | 9. Effon Series (New Series)      |
| 5. Itagunmodi Series (New Series) | 10. Igbajo Series (New Series)    |

*D.—Hill Wash Material :*

- |                  |                  |
|------------------|------------------|
| 1. Aponmu Series | 3. Mokore Series |
| 2. Iregun Series |                  |

*II.—Poorly Drained Soils*

- |                  |                              |
|------------------|------------------------------|
| 1. Matako Series | 4. Shasha Series             |
| 2. Jago Series   | 5. Majeroku Series           |
| 3. Adio Series   | 6. Lagun Series (New Series) |

*III.—Swampy Soils*

- |                 |                 |
|-----------------|-----------------|
| 1. Ikire Series | 2. Oshun Series |
|-----------------|-----------------|

Brief descriptions of the nine new Soil Series recognised during the period under review are given below.

Four of these Series form the upper part of a catenary sequence which occurs over the Quartz Schist formation (Iwaji, Okemessi, Erinoke, and Iddo-Irapa Series). The transported soils of the lower part of this catena have been included in the Aponmu, Matako, Jago and Ikire Series.

*I.—Well Drained Soils*

*A.—Skeletal Soil :*

*Iwaji Series.*—Found on the tops of some of the Quartz Schist ridges between Ilesha and Effon Alaiye. A dark greyish black humic slightly clayey sand with few to frequent pieces of quartz schist down to about 5 to 7 inches where the colour becomes pale. Very little fine earth material occurs below 20 inches and pieces of quartz or quartz schist become dominant.

*B.—Formed from Residual Material :*

*Mamu Series.*—Pale reddish brown clayey soils formed from material originally derived from sericite schists. This Series occurs on the upper slopes and is found associated with Effon Series in the sericite and quartz-schist areas.

*C.—Hill Creep Material :*

(i) *Itagunmodi Series.*—A dark reddish-brown fine sandy clay soil frequently 6 or 7 feet deep with only traces of fine quartz gravel and few small concretions. It is derived from tremolite schists or amphibole material and small pieces of this type of rock are frequently encountered in the profile.

(ii) *Okemessi Series.*—Found mainly on steep slopes, on quartz schist ridges, greyish brown to brown sandy soil usually with frequent to very frequent pieces of quartz schist down to about 30 inches ; below this a reddish brown coarse sandy clay with frequent quartz schist may occur.

(iii) *Erinoke Series.*—Found mainly on moderate slopes, where hard quartz bands are less frequent in the schist than in the case of the Okemessi Series. This soil consists of brown clayey sand over brownish red coarse sandy clay which may contain some quartz schist or quartz sericite schist throughout the profile or be completely devoid of this material to at least 30 inches.



(iv) *Iddo-Irapa Series*.—Found in small amounts in association with Okemessi and Erinoke Series, and partly formed from local hill-wash material. Brownish-grey to brown coarse sandy soil with some gravel, to about 24 inches ; more clayey below. Mottled decomposed rock may be found at 36 to 48 inches.

(v) *Effon Series*.—A pale brown or pale reddish brown clayey soil usually containing some quartz gravel. Below 10 inches appreciable amounts of sericite schist may occur, and at 30 to 36 inches it consists almost entirely of large pieces of this pale fine powdery schist.

(vi) *Igbajo Series*.—Shallow brown fine-sandy clay over a great depth of fine powdery kaolinised porphyritic granite, on the top of steep hills near Ikirun ; noted during a preliminary visit.

## II.—Poorly Drained Soils

*Lagun Series*.—Rather similar to the Mokore Series but not necessarily associated with basic rocks. The poorly drained condition is more often due to impeded drainage than to a true water table. A pale brown or greyish brown clayey soil with frequent small round concretions in a very mottled clay matrix at about 20 to 30 inches. This series is being investigated further.

A complete list, with brief descriptions, of the Soil Series and their variations which have so far been recognised and described is available for distribution to those interested. It should be appreciated that much work is still being done on the exact nature of these soils, and the classification may require to be modified in the light of later knowledge.

## SOIL ASSOCIATIONS

The various soil series, which are the units of classification for detailed soil mapping, form a number of "Associations" occupying distinguishable areas. An association corresponds roughly to one type of landscape over a particular rock formation, and it usually has four or more soil series occurring in sequence from hill-slope to valley bottom. About eight soil associations will be shown on a map on the scale of 1/125,000 which is being prepared. Information is not yet complete, but the following is a provisional list of the soil associations which will be mapped in the Cocoa Belt of Ibadan and Oyo Provinces :—

- (1) Egbeda-Olorunda-Apomu-Iregun Association
- (2) Iwo-Ibadan-Asejire-Apomu Association
- (3) Asejire-Balogun-Apomu Association
- (4) Balogun-Igbajo-Ekiti Association.
- (5) Okemessi-Erinoke-Apomu Association
- (6) Effon-Olorunda-Apomu Association
- (7) Itagunmodi-Araromi Association
- (8) Araromi-Mokore Association.

## SURVEYS FOR THE WESTERN REGIONAL PRODUCTION DEVELOPMENT BOARD

Considerable interest has arisen in the establishment of citrus farms in the area around Ibadan as a result of the proposed canning factory. Land suitable for cocoa is also very satisfactory for citrus but as the former crop is at present more profitable, the policy is to plant citrus on the less fertile soils. This has required careful supervision to ensure that soils unsuitable for citrus are not used for this crop. Brief inspection by a Soil Scientist, with systematic sampling of those plots thought likely to be at all suitable, has been the usual procedure. This has entailed the examination of about sixty plots with a total area of approximately 2,000 acres, although the majority of the plots examined in detail were less than 20 acres each in extent. Advice has also been given to the Board on the suitability of certain soils for the production of rice. Table 2 lists the main areas which have been reported on by the Section to the Projects Manager.



TABLE 2

| <i>Projects Surveyed</i>                | <i>Approximate<br/>Acreage</i> | <i>Recommendations or Remarks</i>        |
|-----------------------------------------|--------------------------------|------------------------------------------|
| Oshun Ebude Epo .. ..                   | 640                            | A preliminary survey for cocoa or citrus |
| Oye Egusi Co-operative plantation ..    | 100                            | Not suitable for citrus                  |
| Igbira Ekiti Co-operative plantation .. | 180                            | Oil palm and food crop                   |
| Oke Pataki (5 plots) .. ..              | 20                             | Cocoa, citrus, food                      |
| Wasimi (2 plots) .. ..                  | 600                            | Not suitable for citrus                  |
| Odeyinka (6 plots) .. ..                | 100                            | Very varied soils                        |
| Near Ikire (4 plots) .. ..              | 45                             | Mainly citrus or food                    |
| Near Asejire (3 plots) .. ..            | 20                             | Poor sandy soils                         |
| Oke Ogun (15 plots) .. ..               | —                              | Mainly suitable for citrus               |
| Offa Igbo (2 plots) .. ..               | 560                            | Mainly suitable for citrus               |
| Odo-Oba .. ..                           | 100                            | Partially suitable for citrus            |
| Awa Arigidi .. ..                       | 295                            | Mainly farming and oil palm              |
| Ijebu Waterside (several acres) .. ..   | —                              | Some suitable for rice                   |

A visit was made with the Projects Manager to Benin Province and the northern part of Delta (Warri) Province to inspect the sites of some proposed rubber and oil-palm plantation projects. Three Temporary Soil Survey Assistants were then lent to the Board to cut grids of traverses across these projects and collect a number of soil profiles for inspection at Ibadan. The soils (apart from small patches) were all of the featureless reddish Benin Type, but showed a very considerable range in mechanical composition, from areas having loose slightly clayey sand to 30 inches or more, to those having a good loamy consistence in the topsoil and coarse sandy clay below. A selection of the profiles has been kept for laboratory analysis. Four sites were visited by the Senior Chemist. One (near Ewohimi) was found to have a very loose coarse sandy soil, and its abandonment was recommended. The other three (near Akwukwu-Igbo, Igueben, and Utagba-Uno) were considered satisfactory; it was suggested that an area of cocoa be planted at Igueben, using a certain amount of fertilizer, as the physical properties of the soil seemed very suitable. Other sites, from which soil samples were collected for inspection at Ibadan, were at Usonigbe, Ewohimi (a new site) and Ubulu-Uku; these were all reported on favourably.

#### SURVEYS OF THE SWOLLEN SHOOT CUT OUT AREAS

The policy of the Department is to rehabilitate cocoa farms inside the Cordon Sanitaire which have been cut out owing to infection with Swollen Shoot Disease. This has necessitated deciding whether citrus or cocoa is more suitable for replanting.

In some cases the soil from individual plots has been briefly examined and reported on. There is always the possibility that further out-breaks may occur which will necessitate additional cutting out and subsequent soil examination. Therefore, it was decided to make systematic soil maps of areas of 40 acres around the centre of each out-break.

A routine procedure was initiated, whereby relatively junior staff lay out a base-line and traverse lines and obtain soil profile samples from a grid 5 chains by  $2\frac{1}{2}$  chains. These are examined at a base office. Reports including a soil map, present Land Use maps, and recommendations on the suitability of the soils for various crops, are prepared. Several larger areas of 360 acres were also surveyed. Detailed contour maps with form lines at 20 feet intervals are included in the reports. To date, twelve surveys of 40-acre blocks have been carried out. It is proposed that all the Cut Out Areas inside the Cordon Sanitaire will be surveyed, before deciding on the method of rehabilitation.

#### ADDITIONAL SURVEYS OF SPECIAL AREAS

In the early part of the year, several large semi-detailed surveys were carried out east of Ibadan near Egbeda, Laduntan and Ajia, representing a total of about 23 square miles. In addition to providing certain information of benefit to the Cocoa Rehabilitation Section, these surveys provide training in the improved methods and techniques which are now in



use. The chief object, however, was to study in some considerable detail the Egbeda-Olorunda-Apomu-Iregun Association which had been recorded and mapped in this locality during the Reconnaissance Survey of the Omi-Shasha Area.

A similar type of survey was carried out near Okebode in the Ilesha area where soils derived from rocks of the Amphibolite complex had been recorded during the Reconnaissance Survey of that district. It was about  $1\frac{1}{2}$  square miles in extent and was surveyed in the now usual manner with traverses 10 chains apart; sampling holes are at 5 chain intervals. Maps were prepared showing contours, present land use, and soils, with a critical appraisal.

A soil survey of Moor Plantation was completed. Other semi-detailed surveys made during the year include :—

|                                                  |             |
|--------------------------------------------------|-------------|
| (1) Okebode semi-detailed survey .. .. .         | 970 acres   |
| (2) Ajia semi-detailed survey .. .. .            | 1,980 acres |
| (3) Egbeda semi-detailed survey .. .. .          | 4,000 acres |
| (4) Laduntan semi-detailed survey .. .. .        | 8,640 acres |
| (5) Aponmu-Akure Co-operative plantation .. .. . | 150 acres   |
| (6) Several T.38 Cocoa Multiplication plots.     |             |

#### WORK IN CO-OPERATION WITH ECONOMIC SURVEY OF THE COCOA PRODUCING AREAS

The Senior Chemist-in-Charge was requested to comment on the soils cultivated by certain families which were being studied by the staff of the Economic Survey. Soils from each parcel of land owned by fifteen families in Ikire, and by five families in Ajia and Okebode, were examined and classified. This involved the examination of several hundred samples. A report is in preparation for inclusion in the Report of the Economic Survey.

#### LABORATORY AND SOIL MUSEUM

A museum of several hundred soil profiles encountered in the various surveys has been started at Moor Plantation for reference purposes.

### CHEMISTRY WORK IN THE NORTH

#### STAFF

|               |                |
|---------------|----------------|
| H. Irving     | <i>Chemist</i> |
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### FERTILIZER EXPERIMENTS

#### PHOSPHATE INVESTIGATIONS

The Chemistry Section has investigated the phosphate requirements of various crops in different areas of Northern Nigeria. The requirements for guinea-corn and groundnuts have been determined in particular areas where superphosphate is the only fertilizer required. Other investigations include placement, time of application and comparison of phosphates in different forms.

In experiments with guinea-corn, yields were significantly increased by phosphate applications. The response to monammonium phosphate was apparently greater than that associated with superphosphate. The difference between these two forms of phosphate was not statistically significant.

#### RESIDUAL EFFECTS OF PHOSPHATE

Residual results of phosphate applications follow the finding of previous years, which have normally shown an increase in yield especially with groundnuts where plots have had phosphate dressing. The trends are quite marked and often show significance, with superphosphate consistently better though not significant over other phosphate carriers. Residual effects lasting two years are fairly common, and there has been a case of residual effect persisting significantly to the fourth year after application.



## NITROGEN AND PHOSPHATE APPLICATIONS

In order to ascertain the fertilizer requirements for principal food crops in Ilorin Province a series of experiments applying nitrogen and phosphate were laid down at three centres. This is an area in which fertilizer requirements have not previously been fully investigated, and containing soils differing considerably from those in the main "phosphate response" areas, and bordering the "nitrogen response" areas of the Western Region. Each centre had nine experiments three for each of the three principal food crops namely: yams, early maize and guinea-corn. The three centres were Paiye, Ballah and Oke Oyi. The rates of application were  $N_1$  &  $N_2$ , 60 and 120 lb per acre respectively of sulphate of ammonia; 60 lb per acre superphosphate.

### YAMS

The results are extremely variable in all centres with no significant results. There is, however, a definite indication that nitrogen is required to increase yields.

### MAIZE

In these experiments, the fertilisers were applied to the early maize which was later interplanted with guinea-corn. The preliminary trials indicated the need for phosphates and nitrogen at Paiye and Oke Oyi respectively. At Ballah, however, both types of fertilizer would be required for early maize crops. The observation that guinea-corn in all three experiments at Paiye responded significantly to phosphate applications on the early maize is interesting and is worthy of further investigation.

## MINERAL DEFICIENCIES

### SULPHUR DEFICIENCY IN GROUNDNUTS

The effect of sulphur on yields of groundnuts has been investigated during the past four years at Kontagora in Niger Province and at the Northern Research Station, Samaru. Applications of sulphur—containing compounds either as a dust or as a soil amendment have almost invariably produced significant increases at Kontagora in both kernel and haulm yields. At Samaru, however, the effect has not been consistent, varying with year and soil conditions.

#### *Residual Effects of Sulphur*

*Kontagora.*—There were five experiments which had had some type of sulphur treatment in 1951. Three of these were planted to *Mucuna* in 1952 and showed no reaction to residual sulphur. The other two experiments were planted to groundnuts which gave no significant results. There was in both experiments a definite trend for increased haulm production on the sulphur treated plots. The kernel response was variable but in both cases calcium sulphate gave the best yields.

*Samaru.*—In five experiments where various sulphur compounds had been applied in 1951, residual effects were shown by increases in both kernel and haulm yields in 1952.

#### *Comparison of Calcium, Magnesium and Sodium Sulphates*

Experiments were undertaken to investigate the effect of sulphates applied in the forms of calcium sulphate, magnesium sulphate and sodium sulphate, each at two levels of application. Four such experiments were laid down one each at Kontagora, Samaru, Kano and Yola. The latter two sites are centred in large groundnut growing areas and were included to ascertain the sulphur status of the area.

The results of these new experiments were insignificant except at Kontagora where again sulphur applications have significantly increased the yield of both kernels and haulms.

*Kontagora.*—The three base forms of sulphates, all containing equal amounts of sulphur, have significantly increased the yields of kernels and haulms when applied at the double rates (equivalent to 17.2 lb of sulphur per acre). The three types of sulphates did not differ significantly among themselves. The average effect was to increase kernel yield by 158 lb. (61.2 per cent).

*Samaru.*—There was no effect on kernel of haulm yields due to the application of sulphur in any form. The applications did tend to be slightly deleterious in reducing shelling percentage as a whole. In the case of sodium sulphate a reduction of 2.8 per cent was obtained which is significant at the 5 per cent level.

*Kano.*—Here the trend of sulphate treatments is to decrease yields. The single rates all showed decreased yields and double rates with exception of calcium sulphate showed a further reduction.

*Yola.*—The trend at this station follows that of Kano as regards magnesium and sodium sulphates, that is to show reduced yields with additional applications. Calcium sulphate, however, showed slight increase for increased rates. All treatments tended to lower shelling percentages as at Samaru.

#### OTHER MINERAL DEFICIENCIES

Leaf painting tests were carried out on citrus in several areas, in an attempt to discover whether the chlorosis present was due to a minor element deficiency, without success.

A chlorosis in Neem seedlings at Maiduguri and Zaria forestry nurseries has been observed during the past two years. This section in co-operation with the Forestry Department has set up pot experiments to ascertain if the chlorosis is due to a mineral deficiency or a breakdown of chlorophyll by high temperatures during the latter part of the wet season.

### CHEMISTRY WORK IN THE SOUTH

#### STAFF

|                |                                         |
|----------------|-----------------------------------------|
| Dr H. Vine     | <i>Senior Chemist</i>                   |
| J. M. L. Kowal | <i>Agricultural Development Officer</i> |
| V. J. Weston*  | <i>Soil Scientist</i>                   |
| L. A. Heapy    | <i>Chemist</i>                          |

Dr H. Vine continued to be on secondment to the Western Region as Officer-in-Charge of the Cocoa Soil Survey, and as in the previous year, he also took charge of the Chemistry Section of the Central Research Organisation. This arrangement made it possible for analytical work to be carried out on selected soil profiles collected in the course of the Soil Survey.

Apart from analyses of the Soil Survey profiles, the work undertaken was mainly concerned with studies of soil fertility and fertilizer experiments.

### FIELD EXPERIMENTS AT MOOR PLANTATION

#### H. VINE

During 1952, cropping continued as before on rotation and green-manuring experiments at Moor Plantation, Ibadan. A division of land was made between the Central Research Organisation and the Western Region School of Agriculture, in which seven 5-acre blocks which had been used for many years in soil fertility experiments, and which were most suitable as regards evenness of slope, were retained for two new experiments which were started at the beginning of 1953.

One of the main results of the work at Moor Plantation is the demonstration that these soils, known to be typical of a large part of the Western Region, are capable of being very productive under intensive cropping. Yields were maintained at a good level during the first ten years of these experiments at Moor Plantation. Thereafter, they decreased gradually. It has been shown that this was mainly due to deficiency of nitrate, which was associated with a decreasing humus content. On the other hand, the high fertility of the soils when brought into cultivation from bush fallow depends on the rapid nitrification of organic nitrogen compounds. The maintenance of fertility is largely attributable to the fact that nitrate, calcium, and other plant nutrients are not leached at excessive rates in the moderate—rainfall conditions of this climatic belt.

\* In charge of section from 17-4-50 to 31-4-53.



Earlier work had shown that a green-manure (*Mucuna*) behaves like a soluble nitrogen fertilizer (sulphate of ammonia) at Ibadan. This observation has been fully justified by later work. The practical question of whether to use *Mucuna* or fertilizer, as the source of nitrogen in these conditions, is a matter of relative costs.

It is now considered that for satisfactory maintenance of yields on these soils, fallow periods under dense vegetative growth to restore the humus content, are essential. Good results should be obtained from the use of the grass-legume mixture (*Cenchrus sp.* and *Centrosema pubescens*) which is being used for pastures on various parts of Moor Plantation. Alternation of a three years' resting period under this mixture, with six years of rotational cropping, appears likely to be satisfactory. This system would be suitable in cases where the roots and stumps necessary for regrowth of a good bush fallow have not survived repeated cycles of farming, or have been removed to permit mechanical cultivation.

#### RESULTS OF FERTILIZER EXPERIMENT ON ROTATION P

Results from this experiment have appeared in previous Annual Reports. A summary is given in Table 3. The cropping in this rotation was as follows:—

| 1st Year              | 2nd Year      | 3rd Year               | 4th Year      |
|-----------------------|---------------|------------------------|---------------|
| Early maize           | <i>Mucuna</i> | Yams                   | Cassava       |
| Cotton }<br>Cowpeas } | Late maize    | Cassava }<br>Cowpeas } | <i>Mucuna</i> |

The treatments were:—

o, p, pk, n, np, npk

p=superphosphate at 2 cwt per acre

n=sulphate of ammonia at 3 cwt per acre

k=muriate of potash at 1 cwt per acre

The fertilizers were applied twice in the rotation, to the yams in the 3rd year and to the maize in the first year (except that in 1947 only phosphate and potash were applied to the maize, and the nitrogen was applied to the cotton crop.)

TABLE 3

#### FERTILIZER EXPERIMENT ON ROTATION P

Early maize yields in lb of dry grain per acre.

Yam yields in lb per acre (gross yields minus weight of planting material).

(Notes.—(1) In 1950 and 1951 maize yields were reduced to about 200 lb per acre by severe attacks of Rust, *Puccinia polysora*.

(2) In 1949 there was only 28 per cent establishment of yams, due to unsatisfactory planting material).

|                  | Field | o     | n      | p     | np     | n<br>Effect | p<br>Effect |
|------------------|-------|-------|--------|-------|--------|-------------|-------------|
| (1) EARLY MAIZE: |       |       |        |       |        |             |             |
| 1946 .. .. .     | D5N   | 1,375 | 1,987  | 1,571 | 2,423  | 732†        | 316†        |
| 1947 .. .. .     | B4W   | 1,696 | —      | 1,704 | —      | —           | 8           |
| 1948 .. .. .     | Z7N   | 1,724 | 2,668  | 1,955 | 2,923  | 956†        | 243†        |
| 1949 .. .. .     | Z5S   | 1,854 | 2,672  | 2,069 | 2,857  | 799*        | 196*        |
| (2) YAMS:        |       |       |        |       |        |             |             |
| 1947 .. .. .     | Z5S   | 9,296 | 15,810 | 8,544 | 16,560 | 7,265†      | —1          |
| 1948 .. .. .     | D5N   | 6,504 | 8,432  | 6,276 | 10,180 | 2,691*      | 985         |
| 1949 .. .. .     | B4W   | —32   | 1,270  | —118  | 460    | 940         | —448        |
| 1950 .. .. .     | Z7N   | 5,414 | 9,298  | 6,306 | 7,582  | 2,580†      | —412        |
| 1951 .. .. .     | Z5S   | 9,650 | 16,181 | 9,676 | 14,505 | 5,680*      | —825        |

\* Significant at 20 per cent level.

† Significant at 100 per cent level.

Potash had no apparent effect on yields, therefore, it is not liable to become deficient in these soils (derived from parent rocks which contain much potash). The Table shows large responses to sulphate of ammonia on every occasion and some response of maize to superphosphate.

#### NEW GREEN-MANURING EXPERIMENT

This is a randomised block experiment with eight replications occupying four sites, each of two acres, in the old experimental fields. The main treatments are six rotations, with varying frequencies of green-manuring. A comparison of burning of *Mucuna* with digging-in-green is made on sub-plots. The experiment is based on one of the most important of the original experiments on green-manuring, which was carried out from 1923 to 1933 on land newly cleared from secondary forest. Comparing the yields of maize (or yams or cotton) grown immediately after *Mucuna* in this experiment with those of maize (or yams or cotton) grown immediately after another crop showed that *Mucuna* had very little manuring effect on the subsequent crop on such land; the new experiment, on land depleted of organic matter, is expected to show a substantial manuring effect. A dressing of sulphate of ammonia at 1 cwt per acre is being applied twice in four years in each rotation, on account of the present low level of nitrogen supply in these soils. The effect of this will not be so great as to mask the manuring effect of *Mucuna*.

The experiment is intended to elucidate some of the previous results and to obtain confirmatory evidence of some conclusions which are of a somewhat indirect nature. The comparison between burning and non-burning is being made because the previous comparisons were only done in the case of annual cropping with maize and *Mucuna*.

#### EXPERIMENT ON FALLOWS AND RESTORATION OF SOIL FERTILITY

H. VINE AND J. H. GISBORNE

This experiment occupies 25 acres of the old experimental fields. The purpose is to investigate by crop yields, soil analyses, and comparison of manured and un-manured sub-plots, the restoration of fertility to these soils (where the organic matter has been seriously depleted) by the use of bush fallows and grass-legume fallows.

The following are the main treatments (to be compared on a long-term basis):—

- (a) Three years *Cenchrus-Centrosema*, three years cropping
- (b) Six years *Cenchrus-Centrosema*, three years cropping
- (c) Three years *Cenchrus-Centrosema*, six years cropping
- (d) Six years bush fallow, three years cropping
- (e) Six years bush fallow, six years cropping
- (f) Continuous cropping

In order to have a test-crop to give a comparison between all the treatments every year it would be necessary to have six plots of (a) started in successive years, nine of (b), (c), and (d), and twelve of (e) in each replication. However, the number of plots for each replication has been cut down to sixteen, by arranging to have a test-crop only once every three years.

The bush fallow is being deliberately planted using typical local species and establishment will therefore be slow. In cases where "bush fallow" plots will be due for cropping in the fourth year it is necessary to substitute *Cenchrus-Centrosema* fallow. The bushfallow will be planted after the first cycle of cropping.

#### FERTILIZER EXPERIMENTS IN WESTERN REGION

H. VINE

During 1952 it was decided that experiments with fertilizers in the Western Region should be allocated as follows:—

(1) Simple one-season trials carried out on groups of farmers' plots (experiments generally carried out entirely by Provincial Agricultural Staff).



(2) Longer-term experiments, with fertilizer applications at various rates, using the usual formal lay-outs appropriate to Experiment Stations, and generally intended to last for about six to eight years (experiments closely supervised by the Chemistry Section).

(3) Application of fertilizers in long-term experiments with fallows and green-manures, as a means of studying their effects on the fertility of the soil (experiments limited to Moor Plantation).

It was arranged, however, that simple trials on farmers' plots should be carried out during 1953 at two places Ogbomosho and Eruwa by the Chemistry Section, as part of an investigation of soil fertility in the savannah areas.

#### FARMER'S PLOT TRIALS IN SOUTH-WESTERN ABEOKUTA PROVINCE.—J. N. W. NICCOLLS

Trials on late maize were carried out in 1952 in the area between Ipokia ( $6^{\circ} 31' N$ ,  $2^{\circ} 51' E$ ) and Ihumbaw ( $6^{\circ} 41' N$ ,  $2^{\circ} 52' E$ ). Similar trials were started on the early maize crop in the same area in 1953. For each trial, a block measuring 40 by 30 yards was chosen after the crop had germinated. This was divided into four plots (20 by 51 yards or practically  $1/16$ th acre). Treatments were as follows :—

- o no application
- n 2 cwt sulphate of ammonia per acre
- p 2 cwt superphosphate per acre
- np 2 cwt of sulphate of ammonia plus 2 cwt of superphosphate per acre.

Eighteen trials on late maize were successfully harvested, with the results shown in Table 4. In this particular area and season superphosphate was without effect, but use of sulphate of ammonia at this rate (2 cwt per acre) was profitable. The cost of the fertilizer (£3-0s-0d) and its application (5s) was more than offset by the value of the increase in yield of grain (410 lb) which amounted to £4-2s-6d. This represented a profit of £0-17s-6d per acre.

TABLE 4  
FERTILIZER TRIALS IN IPOKIA—IHUMBAW AREA WITH LATE MAIZE IN 1952

| <i>Treatment</i> | <i>Yield</i>    |
|------------------|-----------------|
| o                | 784             |
| n                | 1,196           |
| p                | 782             |
| np               | 1,189           |
| Effect of N      | 410 lb per acre |
| Effect of P      | —5 lb per acre  |
| NxP Interaction  | —3 lb per acre  |

#### COMPARISON WITH 1951 RESULTS FOR SOUTH-WESTERN ABEOKUTA PROVINCE—H. IRVING AND J. N. W. NICCOLLS

The experiments on late maize in this area in 1951 are listed below. They were mentioned briefly in last year's report.

(i) three 27-plot factorial experiments (with N, P, and K each at three levels) with plots of normal size ;

(ii) two similar 27-plot factorial experiments with micro-plots ;

(iii) trials on farmers' plots (seven successfully harvested) with sulphate of ammonia applied as follows :—

- (a) nil,
- (b)  $1\frac{1}{2}$  cwt per acre at thinning time,
- (c)  $\frac{3}{4}$  cwt per acre at thinning time and  $\frac{3}{4}$  cwt per acre at tasselling time.

Rates of application in the 27-plot factorial experiments were:—

$n_0$ ,  $n_1$ ,  $n_2$ , 0, 1, and 2 cwt per acre sulphate of ammonia;  $p_0$ ,  $p_1$ ,  $p_2$ , 0, 1, and 2 cwt per acre superphosphate;  $k_0$ ,  $k_1$ ,  $k_2$ , 0,  $\frac{1}{2}$  and 1 cwt per acre muriate of potash.

The results of these experiments are summarized in Table 5. The figures represent the yields in lb dry grain per acre, but actual shelling percentages were not determined.

TABLE 5

FERTILIZER TRIALS IN SOUTH-WESTERN ABEOKUTA PROVINCE WITH LATE MAIZE IN 1951  
Yields and Average increase (*italics*) for each level of fertilizer application as weight of grain per acre (Note 3)

| Expt | $n_0$ | $n_1$              | $n_2$              | $p_0$ | $p_1$              | $p_2$              | $k_0$ | $k_1$              | $k_2$              |
|------|-------|--------------------|--------------------|-------|--------------------|--------------------|-------|--------------------|--------------------|
| A    | 612   | +129               | + 85               | 301   | +587 <sub>xx</sub> | +562 <sub>xx</sub> | 695   | -115               | + 39               |
| B    | 342   | + 83               | +137               | 418   | + 0                | - 8                | 415   | + 8                | - 9                |
| C    | 229   | + 70 <sub>xx</sub> | + 61 <sub>xx</sub> | 285   | - 5                | - 34               | 261   | + 12               | + 23               |
| D    | 213   | + 45 <sub>x</sub>  | + 27               | 193   | + 76 <sub>xx</sub> | + 68 <sub>xx</sub> | 201   | + 56 <sub>xx</sub> | + 62 <sub>xx</sub> |
| E    | 657   | +148 <sub>x</sub>  | +223 <sub>xx</sub> | 728   | + 82               | + 77               | 683   | +124 <sub>xx</sub> | +172 <sub>xx</sub> |
| Mean | 411   | + 95               | + 107              | 385   | + 148              | + 133              | 451   | + 17               | + 56               |

Note.—1 A Expt. STP 2(51)  $\frac{1}{2}$  mile north of Ipokia Rest House  
B Expt. STP 5(51) Oke Awdan  
C Expt. STP 7(51) Two miles from Ifonyintedo on Ihumbaw road  
D Expt. STP 3(51) Micro-plot expt. beside STP 7(51)  
E Expt. STP 4(51) Micro-plot expt. Four miles from Ihumbaw on Ipokia road.

Note.2—x= Significant at 20 : 1 level  
xx= Significant at 100 : 1 level

Note.3—Yields were recorded as unhusked cobs, which were converted to grain by the factor 60/100 since approximate average shelling percentage is 60 per cent.

The outstanding result in these twenty-seven plot experiments was the great response to phosphate in the Ipokia experiment, No. STP 2(51), which also showed a significant positive N<sub>x</sub>P interaction. In the presence of phosphate, sulphate of ammonia at 1 cwt per acre gave an increase of 364 lb unhusked cobs (approximately 220 lb dry grain) per acre, and 2 cwt gave no further increase over this amount. This experiment was sited on a poor greyish sand, which forms a belt about four miles wide running eastwards from the Dahomey border for twenty miles or more, immediately north of the swamp belt and well below the 100 feet contour. Crops on this soil are very poor, and the oil-palms appear stunted.

The other four experiments were on red soil of the 'Benin Type'. They represent areas of good farming on a well-managed bush-fallow-rotation system, where maize is the most important crop. Cropping is more intensive in the southern part (between Ipokia and Ihumbaw) than further north. In these experiments, a moderate degree of attack by maize rust (*Puccinia polysora*) was recorded. Sulphate of ammonia was the most effective fertilizer, but only in experiment STP 4(51) did it give a worthwhile return.

The trials on farmers' plots gave the following average yields of dry grain:—

- (a) No manure .. .. 622 lb per acre.
- (b) Single dressing .. .. 729 lb per acre (+107 lb).
- (c)  $\frac{1}{2}$  and  $\frac{1}{2}$  dressing .. .. 725 lb per acre (+103 lb).

A general indication is that 1 cwt sulphate of ammonia, or of superphosphate, per acre is likely to be nearly as effective as 2 cwt in this area.

#### FARMER'S PLOT TRIALS IN ILESHA AREA—G. E. UDOM

Trials on late maize in an area around Ilesha were carried out for the Farmer's Plot Trials in South-Western Abeokuta Province. The area was known to be one of generally superior soils, giving good crops of maize and yams. Vigorous bush growth formed the fallows and



there was no invasion of grass. Efforts to increase food production, in order to bring down local prices, had been specially requested, and it was decided to do fertilizer experiments for this reason. Eleven trials were successfully harvested, giving the following results : —

|                                     |                                                                                  |       |     |       |
|-------------------------------------|----------------------------------------------------------------------------------|-------|-----|-------|
| Treatment                           | o                                                                                | n     | p   | np    |
| Mean yield (lb. dry grain per acre) | 1,034                                                                            | 1,078 | 927 | 1,126 |
| Mean effect of N                    | $= \frac{1}{2}(1,078+1,126-1,034-927)$<br>$= 122 \text{ lb dry grain per acre.}$ |       |     |       |
| Mean effect of P                    | $= \frac{1}{2}(927+1,126-1,034-1,078)$<br>$= 30 \text{ lb dry grain per acre.}$  |       |     |       |

Although the increased yield from use of sulphate of ammonia was only 122 lb per acre, observations during October and November showed a pronounced beneficial effect. The average yields of the blocks of four plots were :—

|          |                    |
|----------|--------------------|
|          | <i>lb per acre</i> |
| 1 block  | 700                |
| 5 blocks | 870-980            |
| 4 blocks | 1,080-1,250        |
| 1 block  | 1,460              |

Similar trials on yams and early maize were laid out in this area at the beginning of 1953.

FERTILIZER EXPERIMENT AT AGEGE

An experiment on a rotation of maize and cassava, with four replications of the usual twenty-seven plot factorial layout (N, P, and K each at three levels) was started at the Experimental Farm at Agege in 1951. Results to date show a significant response to phosphate in the case of maize.

EXPERIMENTS AT ERUWA—H. VINE AND J. M. L. KOWAL

A fertilizer experiment on early maize was carried out at the Eruwa Group Farming Scheme of the Western Region Production Development Board. This scheme occupies about 500 acres at New Eruwa (7° 33' N, 3° 27' E) in the Derived Savannah Zone. The Scheme was laid out in contour strips, and alternate strips were cropped and left fallow. The first year of cropping was 1952, which followed ploughing of dominantly grassy vegetation. Nitrate deficiency was expected to have a markedly adverse effect, but proved to be extremely severe.

Except for the area chosen for the experiment, the Board applied a dressing of superphosphate to the early maize at planting time. Very promising growth was observed in the first few weeks, this was probably partly due to the superphosphate. Sulphate of ammonia, which it was planned to apply, failed to arrive in time. A few rows of maize received sulphate of ammonia as a dressing when the plants were about 15 inches high, this caused severe scorching at first, but later these rows grew very well in contrast to the rest of the area.

TABLE 6  
FERTILIZER EXPERIMENT AT ERUWA WITH EARLY MAIZE IN 1952  
*Yields in lb Dry Grain per Acre*

|                  |              |                 |
|------------------|--------------|-----------------|
| <i>Treatment</i> | <i>Yield</i> | <i>Increase</i> |
| n <sub>0</sub>   | 96           | —               |
| n <sub>1</sub>   | 232          | 136             |
| n <sub>2</sub>   | 285          | 189             |
| n <sub>3</sub>   | 329          | 233             |
| p <sub>0</sub>   | 162          | —               |
| p <sub>1</sub>   | 258          | 96              |
| p <sub>2</sub>   | 252          | 90              |
| p <sub>3</sub>   | 271          | 109             |

The fertilizer experiment consisted of four replications of a  $4 \times 4$  factorial layout, with sulphate of ammonia and superphosphate each applied at rates of 0, 1, 2, and 3 cwt per acre. The yields, which are summarised in Table 6, were very poor. Unmanured plots gave an average of 57 lb dry grain per acre, it was obvious that they suffered from an extreme shortage of nitrate. The plants were only about 18-24 inches in height, and very yellow. Plots that had 3 cwt of sulphate of ammonia and 2 or 3 cwt of superphosphate per acre still only gave 330 lb of grain per acre. Contributory causes of the poor yield were poor establishment, depredations by bush-fowl, and weed growth. The plants remained yellowish and very stunted, more so than could be attributed to weed growth. Weather conditions were favourable, and there was very little maize rust attack.

During the year it was noticed that grass growth in the country around Eruwa was generally much less vigorous than is usual in this climatic belt. However, the grass within 4 feet of the edge of newly cleared land showed a great increase in luxuriance, suggesting liberation of nitrate in the cleared area, which the adjoining plants were able to use.

Periodic nitrate determinations on a series of plots, including undisturbed grassland, bare ploughed plots, and cropped plots, were started in October. Very low amounts of nitrate were found (about one part of nitrate-nitrogen per million), no accumulation occurred during the dry season whilst accumulation has been shown to occur on a pineapple plot at Moor Plantation.

#### STUDIES OF EXCHANGEABLE BASES IN OIL PALM SOILS—J. M. L. KOWAL

Continuing the studies of exchangeable bases described in the previous report, an EEL Flame Photometer has been used for rapid determinations of potash in ammonium-acetate extracts. These have been in satisfactory agreement with the results obtained by use of the purely chemical method. Attempts to obtain reliable figures for exchangeable calcium in the same way have not been successful. Results have disagreed with those from the chemical method, and are not always reproducible.

### BOTANY SECTION BOTANICAL WORK IN THE NORTH

#### STAFF

|                |                                         |
|----------------|-----------------------------------------|
| J. H. Gisborne | <i>Principal Agricultural Officer</i>   |
| W. E. Freeman  | <i>Senior Botanist</i>                  |
| E. J. Butler   | <i>Agronomist</i>                       |
| A. B. Rains    | <i>Pasture Research Officer</i>         |
| A. R. Maurer   | <i>Botanist</i>                         |
| H. E. King     | <i>Cotton Breeder (E.C.G.C.)</i>        |
| J. Saunders    | <i>Cotton Breeder (E.C.G.C.)</i>        |
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| H. N. Booy     | <i>Agricultural Development Officer</i> |

#### INTRODUCTION

This account of botanical work in the Northern Region of Nigeria is compiled from the Northern Research Station, Samaru, Annual Report 1952-53. In the North, there is an Agronomy Section which is concerned with livestock in addition to field crops. The latter are here considered under the heading of botanical work, for the sake of uniformity with the report on similar work in the South. The work of the Pasture Section of the Northern Research Station is also included under the general heading of botanical work.

A dry spell from late May to mid-June retarded planting (except for millet) and adversely affected the earliest guinea-corn plantings, necessitating heavy supplying. During the third quarter, rainfall was above average, that for July being the heaviest for that month since records were started in 1924. A certain amount of waterlogging occurred and this retarded growth for a time. Final yields in most crops were lower than average.



During the year, in co-operation with the Department of Geography, University College, Ibadan, an evapo-transpirometer was installed and maintained at Samaru and another at Daura. This apparatus is designed to measure water losses by evaporation and transpiration from an area of soil planted (at present) with grass (*Cynodon dactylon*). All figures recorded are forwarded to the Department of Geography, which maintains other evapo-transpirometers in the Eastern and Western Regions, and publishes periodical reports.

Interesting data are being produced which should be of the utmost value in the future, particularly in assessing water requirements for irrigation.

#### RAINFALL SAMARU 1952

|           |    |    |    |        | Previous Average :<br>Twenty-seven years |                     |        |                  |
|-----------|----|----|----|--------|------------------------------------------|---------------------|--------|------------------|
| Month     |    |    |    | Inches | No.<br>Wet days                          | Cumulative<br>Total | Inches | Cumulative Total |
| January   | .. | .. | .. | 0.00   | 0                                        | 0.00                | 0.00   | 0.00             |
| February  | .. | .. | .. | 0.00   | 0                                        | 0.00                | 0.04   | 0.04             |
| March     | .. | .. | .. | 0.14   | 1                                        | 0.14                | 0.32   | 0.36             |
| April     | .. | .. | .. | 0.13   | 1                                        | 0.27                | 1.26   | 1.62             |
| May       | .. | .. | .. | 5.09   | 11                                       | 5.36                | 4.94   | 6.56             |
| June      | .. | .. | .. | 6.27   | 12                                       | 11.63               | 6.42   | 12.98            |
| July      | .. | .. | .. | 13.02  | 23                                       | 24.65               | 8.68   | 21.66            |
| August    | .. | .. | .. | 8.04   | 15                                       | 32.69               | 11.57  | 31.23            |
| September | .. | .. | .. | 9.00   | 17                                       | 41.69               | 8.62   | 41.85            |
| October   | .. | .. | .. | 1.82   | 5                                        | 43.51               | 1.43   | 43.28            |
| November  | .. | .. | .. | 0.00   | 0                                        | 43.51               | 0.03   | 43.31            |
| December  | .. | .. | .. | 0.00   | 0                                        | 43.51               | 0.01   | 43.32            |
| Total     |    |    |    | 43.51  | 85                                       | 43.51               | 43.32  | 43.32            |

#### COTTON—H. E. KING

The variety Samaru 26C now replaces Allen as the commercial cotton of Northern Nigeria and seven selections from this were grown in comparison with "New Nucleus" stock of 26C at eight different localities. Two strains were particularly promising, through giving a relatively large proportion of their total yields in early pickings. This quality of earliness enabled these strains to yield well under low rainfall conditions, as for example at Maiduguri.

Reports on samples from the 1951-52 experiments, sent to the Shirley Institute for testing, have confirmed previous indications that there is wide variation in spinning quality with Samaru 26C material. In general, the better spinning selections have lower ginning percentages, but several giving high yields of seed-cotton have shown a distinct advance on 26C control samples in yarn strength and fineness.

Full details of the results from the season's work have been published in the Empire Cotton Growing Corporation's "Progress Report from Experiment Stations, season 1952-53".

#### GUINEA-CORN (SORGHUM)

The programme initiated by Dr Webster has been continued at Samaru and at several other stations. The collection of imported sorghums was maintained and plant characteristics of each variety were recorded. Successful crosses between Nigerian and American varieties were made.

In a yield and palatability trial with imported varieties, "Hegari" gave the highest yield (1,735 lb per acre of grain) and its quality was acceptable, in that it was similar to the Farafara commonly used. The relatively short stature of the American sorghums, as compared with Nigerian guinea-corn, facilitates harvesting.

## RICE

A collection of over 100 varieties is maintained by the Botanist at the Samaru Dam Site, but the area available is proving inadequate. However, rice work will be taken over in 1953 by the Central Rice Research Station at Badeggi near Bida.

### GROUNDNUTS

#### *Selection Work at Samaru*

The selection programme has been continued and high yielding strains were collected from different populations. This old programme had its chief weakness in the "reselection" from previously discarded strains, and there are indications that none of the strains chosen in 1952 are as good as the earlier ones.

A new collection of possibly heavy yielding strains has been obtained from outstations in the groundnut growing belt and these plants will form the nucleus of a new selection programme in 1953.

#### *Variety Trial No. A1 (52)*

This experiment compares the performance of fifteen varieties of groundnuts and is designed to determine the seasonal variations of certain strains under Samaru conditions. Yields were much poorer than usual. It would appear that certain strains, such as ML. 372, are extremely variable in their response to climatic conditions, their performance fluctuating greatly year by year. Others such as MJ. 371 and Castle Cary are maintaining a fairly steady position near the top of the list but do not come out in first place position very often. Samaru 38 follows almost consistently behind Castle Cary and is only occasionally better. Natal Common has fallen to a low position after a spectacular start in 1949. This variety will not be included in the 1953 trial. Samaru 38 *ex*-Kontagora was included in the 1950 to 1952 trials as it was suspected that it was not true Samaru 38. Although last on the list of averages, it has performed relatively well to date.

#### *Variety Trial No. A6 (52)*

Fifteen varieties, including Castle Cary and Natal Common which were under trial in 1952 (A1) were compared in a balanced lattice experiment. None of the varieties tried were as high yielders as Castle Cary.

#### *Pure Lines Versus Mixtures Yield Trial—A2 (52)*

A series of experiments was started in 1949 to test the hypothesis that mixing of a number of strains in predetermined proportions may give a higher average as being less susceptible to seasonal climatic variations.

The following tables compare results from 1949 to 1952 :—

TABLE 7  
SHOWING YIELD OF UNSHELLED GROUNDNUTS IN LB PER ACRE

| <i>Treatments</i>                  | 1949  | 1950  | 1951  | 1952 | <i>Totals</i> | <i>Average</i> | <i>Position</i> |
|------------------------------------|-------|-------|-------|------|---------------|----------------|-----------------|
| (6) S. 38 .. .. .                  | 1,890 | 1,612 | 1,191 | 748  | 5,477         | 1,369          | 1st             |
| (3) 50 per cent S. 38 .. .. .      | 1,964 | 1,589 | 1,087 | 756  | 5,396         | 1,349          | 3rd             |
| 50 per cent MJ. 374 .. .. .        |       |       |       |      |               |                |                 |
| (5) 25 per cent S. 38, C.C .. .. . | 1,827 | 1,480 | 1,049 | 800  | 5,156         | 1,289          | 5th             |
| MJ. 374, ML. 3710 .. .. .          |       |       |       |      |               |                |                 |
| (7) 50 per cent S. 38 .. .. .      | 1,850 | 1,346 | 974   | 700  | 4,870         | 1,217          | 9th             |
| 50 per cent ML. 3710 .. .. .       |       |       |       |      |               |                |                 |
| (8) Castle Cary .. .. .            | 1,798 | 1,471 | 1,219 | 750  | 5,238         | 1,309          | 4th             |
| (2) 75 per cent MJ. 374 .. .. .    | 1,700 | 1,414 | 1,071 | 710  | 4,895         | 1,224          | 7th             |
| 25 per cent C. Cary .. .. .        |       |       |       |      |               |                |                 |
| (4) ML. 3710 .. .. .               | 1,664 | 1,428 | 1,112 | 680  | 4,884         | 1,221          | 8th             |
| (9) 50 per cent S. 38 .. .. .      | 1,813 | 1,544 | 1,214 | 823  | 5,403         | 1,351          | 2nd             |
| 50 per cent C. Cary .. .. .        |       |       |       |      |               |                |                 |
| (1) MJ. 374 .. .. .                | 1,693 | 1,441 | 1,057 | 824  | 5,015         | 1,257          | 6th             |



TABLE 8  
SHOWING YIELD OF GROUNDNUT KERNELS IN LB PER ACRE

| <i>Treatments</i>              | 1949 | 1950  | 1951 | 1952 | <i>Totals</i> | <i>Average</i> | <i>Position</i> |
|--------------------------------|------|-------|------|------|---------------|----------------|-----------------|
| (6) S. 38 .. .. .              | —    | 1,122 | 822  | 371  | 2,315         | 772            | 1st             |
| (3) 50 per cent S. 38 ..       | }    | 1,100 | 757  | 333  | 2,190         | 730            | 3rd             |
| 50 per cent MJ. 374 ..         |      |       |      |      |               |                |                 |
| (5) 25 per cent S. 38, C.C. .. | }    | 1,047 | 737  | 323  | 2,107         | 702            | 5th             |
| MJ. 374, ML. 3710 ..           |      |       |      |      |               |                |                 |
| (7) 50 per cent S. 38 ..       | }    | 939   | 680  | 322  | 1,941         | 647            | 9th             |
| 50 per cent ML. 3710 ..        |      |       |      |      |               |                |                 |
| (8) Castle Cary .. ..          | —    | 1,003 | 829  | 321  | 2,153         | 718            | 4th             |
| (2) 75 per cent MJ. 374, ..    | —    | 994   | 750  | 320  | 2,064         | 688            | 6th             |
| 25 per cent C. Cary ..         | }    | 980   | 765  | 320  | 2,065         | 688            | 6th             |
| (4) ML. 3710 .. .. .           |      |       |      |      |               |                |                 |
| (9) 50 per cent S. 38 ..       | }    | 1,075 | 845  | 301  | 2,221         | 740            | 2nd             |
| 50 per cent C. Cary ..         |      |       |      |      |               |                |                 |
| (1) MJ. 374 .. .. .            | —    | 973   | 229  | 269  | 1,971         | 657            | 8th             |

Over the four years, Samaru 38 has given the best average yield, and has been the highest yielder of the year once. A mixture of 50 per cent each of Castle Cary and Samaru 38 has given the second best average. The trial will continue, but there is no indication so far that any of the mixtures tried is any more reliable from year to year than the best of the pure lines.

#### *Spacing Trial No. A5 (52)*

Experiments have shown that ridge cultivation is superior to flat. Accordingly, attention has been given to the effect of ridge spacing on yields. The trial now to be described is the final one of a series designed to confirm results obtained at Daura and Kafinsoli, that higher yields of groundnuts can be obtained with closer spacing than that normally adopted in Nigeria. The trials were started in 1950.

The following treatments were incorporated in these trials :—

|                           |   |                                                                                                        |
|---------------------------|---|--------------------------------------------------------------------------------------------------------|
| 1. 9" on 3' ridges ..     | } | Approximately equivalent to present plant population, <i>i.e.</i> , 324 square inches per plant.       |
| 2. 11" on 2' 6" ridges .. |   |                                                                                                        |
| 3. 13½" on 2' ridges ..   |   |                                                                                                        |
| 4. 4½" on 3' ridges ..    | } | Approximately equal to twice present plant population, <i>i.e.</i> , 162 square inches.                |
| 5. 5½" on 2½' ridges ..   |   |                                                                                                        |
| 6. 6½" on 2' ridges ..    |   |                                                                                                        |
| 7. 6½" on 3' ridges ..    | } | Approximately equal to one and a half times present plant population, <i>i.e.</i> , 243 square inches. |
| 8. 8" on 2½' ridges ..    |   |                                                                                                        |
| 9. 10" on 2' ridges ..    |   |                                                                                                        |

The yields over the three years have been as follows (undecorticated, lb per acre)

TABLE 9  
SHOWING YIELD OF UNSHELLED GROUNDNUTS IN LB PER ACRE AT DIFFERENT SPACINGS AND SEASONS

| 1950                 |       |       |       |             | 1951  |       |       |             |
|----------------------|-------|-------|-------|-------------|-------|-------|-------|-------------|
| <i>Ridge width :</i> | 3'    | 2½'   | 2'    | <i>Mean</i> | 3'    | 2½'   | 2'    | <i>Mean</i> |
| Close spacing .. ..  | 1,628 | 1,624 | 1,733 | 1,662       | 1,518 | 1,614 | 1,746 | 1,626       |
| Medium .. .. .       | 1,594 | 1,550 | 1,794 | 1,646       | 1,692 | 1,634 | 1,840 | 1,722       |
| Wide .. .. .         | 1,453 | 1,634 | 1,607 | 1,565       | 1,706 | 1,720 | 1,732 | 1,719       |
| Mean .. .. .         | 1,558 | 1,603 | 1,711 | 1,624       | 1,639 | 1,656 | 1,773 | 1,689       |

TABLE 9—*continued*

| 1952                 |     |     |     |             | MEAN 1950-52 |       |       |             |
|----------------------|-----|-----|-----|-------------|--------------|-------|-------|-------------|
| <i>Ridge width :</i> | 3'  | 2½' | 2'  | <i>Mean</i> | 3'           | 2½'   | 2'    | <i>Mean</i> |
| Close spacing .. ..  | 701 | 803 | 787 | 764         | 1,282        | 1,347 | 1,422 | 1,350       |
| Medium .. ..         | 769 | 798 | 747 | 771         | 1,352        | 1,327 | 1,460 | 1,380       |
| Wide .. ..           | 654 | 707 | 842 | 734         | 1,271        | 1,354 | 1,394 | 1,340       |
| Mean .. ..           | 708 | 769 | 792 | 756         | 1,302        | 1,343 | 1,425 | 1,356       |

The overall indications each year have been in favour of the narrowest ridge (2'). For spacings on the ridge, differences overall are not significant, but in each year the mean of the medium spacing (243 square inches per plant) has come out highest.

#### *Groundnut Seed Dressing Trial—A3 (52)*

This trial is a continuation of a series begun in 1948 to test the effect of seed-dressings on germination and yields of groundnuts.

The 1948 trial, A5 (48), consisted of two compounds applied at two rates and planted at one and two seeds per hole.

The compounds used were :—

A.—Agrosan GN-PP 1551-R4.

(This is a mercurial compound containing 1 per cent of organically combined mercury).

B.—R1104 x 49.

(An experimental non-mercurial dressing containing 50 per cent tetramethyl thiramdisulphide).

In 1950 the trial was conducted with compound B only and the same rates of application were used. Yields are shown below :—

TABLE 10  
SHOWING YIELD OF UNSHELLED GROUNDNUTS IN LB PER ACRE ACCORDING TO  
SEED TREATMENT

| <i>Treatment</i>                                | 1950  | <i>Position</i> |
|-------------------------------------------------|-------|-----------------|
| 1. No dressing, 1 seed per hole .. ..           | 1,398 | (6)             |
| 2. No treatment, 2 seeds per hole .. ..         | 1,473 | (3)             |
| 3. B at 2 oz per 100 lb, 1 seed per hole .. ..  | 1,400 | (5)             |
| 4. B at 2 oz per 100 lb, 2 seeds per hole .. .. | 1,491 | (2)             |
| 5. B at 4 oz per 100 lb, 1 seed per hole .. ..  | 1,449 | (4)             |
| 6. B at 4 oz per 100 lb, 2 seeds per hole .. .. | 1,647 | (1)             |

In 1951 and 1952 a third compound C, commercial "Fernasan", was used as well as compounds A and B. The rates of application were similar, *i.e.*, 2 and 4 oz of dressing per 100 lb of seed.



Groundnut yields in 1952 were not significantly different. A comparison of the 1951 and 1952 results is shown below :—

TABLE 11  
SHOWING YIELD OF UNSHELLED GROUNDNUTS IN LB PER ACRE ACCORDING TO SEED  
TREATMENT OVER TWO YEARS

| <i>Treatment</i>                           | 1951  | 1952 | <i>Average</i> | <i>Position</i> |
|--------------------------------------------|-------|------|----------------|-----------------|
| 12. 'C' at 2 oz/100 lb 2 seed/hole .. .. . | 1,768 | 672  | 1,220          | (1)             |
| 8. 'B' at 2 oz/100 lb 2 seed/hole .. .. .  | 1,734 | 669  | 1,202          | (2)             |
| 6. 'A' at 4 oz/100 lb 2 seed/hole .. .. .  | 1,741 | 661  | 1,201          | (3)             |
| 5. 'B' at 4 oz/100 lb 1 seed/hole .. .. .  | 1,765 | 637  | 1,201          | (3)             |
| 4. 'A' at 4 oz/100 lb 2 seed/hole .. .. .  | 1,748 | 630  | 1,189          | (5)             |
| 13. 'C' at 4 oz/100 lb 1 seed/hole .. .. . | 1,706 | 637  | 1,172          | (6)             |
| 10. 'B' at 4 oz/100 lb 2 seed/hole .. .. . | 1,607 | 733  | 1,170          | (7)             |
| 3. 'A' at 2 oz/100 lb 1 seed/hole .. .. .  | 1,685 | 629  | 1,157          | (8)             |
| 11. 'C' at 2 oz/100 lb 1 seed/hole .. .. . | 1,706 | 595  | 1,151          | (9)             |
| 14. 'C' at 4 oz/100 lb 2 seed/hole .. .. . | 1,674 | 624  | 1,149          | (10)            |
| 5. 'A' at 4 oz/100 lb 1 seed/hole .. .. .  | 1,681 | 584  | 1,133          | (11)            |
| 1. No dressing 1 seed/hole .. .. .         | 1,660 | 586  | 1,123          | (12)            |
| 6. 'B' at 4 oz/100 lb 1 seed/hole .. .. .  | 1,672 | 539  | 1,106          | (13)            |
| 2. No dressing 2 seed/hole .. .. .         | 1,595 | 558  | 1,077          | (14)            |

It will be observed that the treatments with no dressing appear near the bottom of the list. No recommendations can yet be made regarding type of seed dressing or rate of seeding on the basis of these figures as, unfortunately, vacancies were supplied.

Germination counts were taken showing the number of stands with 0, 1 and 2 plants. The following table shows the percentage number of stands containing no plants (before supplying) :

TABLE 12  
SHOWING THE PERCENTAGE VACANT STANDS IN 1951 AND 1952 TRIALS OF SEED TREATMENT  
FOR GROUNDNUTS  
*Seed Dressing*

|                  |    |    |    |    | <i>None</i> | <i>A</i>    |             | <i>B</i>    |             | <i>C</i>    |             |
|------------------|----|----|----|----|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                  |    |    |    |    |             | <i>2 oz</i> | <i>4 oz</i> | <i>2 oz</i> | <i>4 oz</i> | <i>2 oz</i> | <i>4 oz</i> |
| <i>One Seed</i>  |    |    |    |    |             |             |             |             |             |             |             |
| 1951             | .. | .. | .. | .. | 20.6        | 13.9        | 11.4        | 18.6        | 22.7        | 20.7        | 18.0        |
| 1952             | .. | .. | .. | .. | 37.6        | 13.0        | 13.7        | 47.9        | 17.8        | 20.5        | 14.8        |
| <i>Two Seeds</i> |    |    |    |    |             |             |             |             |             |             |             |
| 1951             | .. | .. | .. | .. | 1.3         | 6.4         | 3.8         | 5.0         | 8.5         | 1.8         | 8.0         |
| 1952             | .. | .. | .. | .. | 24.9        | 22.5        | 18.0        | 5.1         | 4.0         | 6.1         | 15.2        |

With planting at one seed per stand, the indication is that in both years, compound A may have produced a real improvement in germination. There is no evidence that the heavier rate of A is better than the lighter one. There is no indication in either year that Compound B has had any good effect (except perhaps at the heavier rate in 1952) and Compound C, while of no value in 1951, may have been beneficial in 1952.

Using two seeds per stand, an almost complete establishment (of one or two plants per stand) was obtained in 1951 with no dressing at all, but a very poor one in 1952. As a consequence, the dressing could not show an improvement in 1951, while in 1952 their results are quite contradictory to the results from one seed per stand, B and C appearing effective and A not effective. The question clearly requires further investigation.

*Method of Planting.*—Three pre-planting treatments were compared in a trial at Maigana. The treatments were as follows : —(a) Seed shelled by hand (b) Seed in shell soaked for 48 hours

(c) Dry seed in shell cracked by rolling between finger and thumb. In the case of this trial the planting rains were good. There was no significant difference between yields, which ranged between 689 and 748 pounds of shelled nuts per acre. It is to be noted that in a previous trial at Kontagora when planting rains were unfavourable, the germination of shelled seed greatly exceeded that of dry seed in shell and that of soaked seed in shell. It is concluded that shelling before sowing is desirable when planting rains are uncertain.

#### SOYA BEANS

A number of varieties were compared with "Benares" and "Malayan" which are regarded as standard. Certain varieties, notably Bilom No. 1 and Bilom No. 3 gave bigger yields than the standards but the differences were not statistically significant.

#### MILLET (*Pennisetum* sp.)

Four local varieties were compared at three different spacings in a trial at Sokoto. The four varieties were Zango, the common local variety, Gergera and Wuyan Bajimi which are grown locally to a small extent and Bornu White, an introduced variety. The spacings on 3-foot ridges were 3 feet,  $4\frac{1}{2}$  feet and 6 feet. The first is the usual local spacing when millet is planted as a sole crop and the last is that used when interplanting with guinea-corn.

TABLE 13

YIELDS OF MILLET IN LB PER ACRE OF FRESH GRAIN AT DIFFERENT SPACINGS

| Spacing              | .. | .. | .. | .. | .. | 3'    | $4\frac{1}{2}'$ | 6'    | Total |
|----------------------|----|----|----|----|----|-------|-----------------|-------|-------|
| Variety Wuyan Bajimi | .. | .. | .. | .. | .. | 624   | 552             | 472   | 1,648 |
| Zango                | .. | .. | .. | .. | .. | 603   | 540             | 478   | 1,621 |
| Gergera              | .. | .. | .. | .. | .. | 495   | 529             | 591   | 1,615 |
| Bornu White          | .. | .. | .. | .. | .. | 667   | 397             | 443   | 1,507 |
| Total                | .. | .. | .. | .. | .. | 2,389 | 2,018           | 1,984 | 6,391 |

There was very little difference between varieties, the wider spacing caused a marked decline in yield although this was not significant. This difference would have been greater if the variety Gergera had not reversed the trend by giving higher yields at wider spacings. Although the results from this experiment are not significant, it is evident that when the common local variety Zango is sown as a sole crop, the normal local spacing of 3 feet is the optimum.

#### BENNISEED (*Sesamum indicum*)

Selection work and yield trials are carried out at Yandev. The two main objectives of the selection programme are early maturity and high yield. Results obtained so far are encouraging. It is hoped that improved strains will be available for distribution in the near future.

#### Family and Strains Trial

This trial consisted of strains reselected in twelve families, previously selected for early maturity and apparently retaining this earliness. There were six randomised blocks of nine families. It was necessary, in some cases, to group two families together to make a set of six strains per family. Unselected Yandev (U) was used as control.

To determine the earliness on a numerical basis, the percentage of mature plants was taken at the time when the first few plants of Yandev Unselected benniseed (planted at the same date) were beginning to reach maturity.

Analysis of yields of strains within families was performed and significant differences were found in families A, E, F and J. This was expected in families F and J since they had a composite make-up.



The analysis between families on the basis of yield, gave the following results :--

#### SUMMARY OF YIELDS

| <i>Family No.</i>                   |    |    |    |    |    |    | <i>lb per acre</i> |
|-------------------------------------|----|----|----|----|----|----|--------------------|
| A                                   | .. | .. | .. | .. | .. | .. | 373.74             |
| H                                   | .. | .. | .. | .. | .. | .. | 346.96             |
| J                                   | .. | .. | .. | .. | .. | .. | 310.57             |
| D                                   | .. | .. | .. | .. | .. | .. | 299.11             |
| U                                   | .. | .. | .. | .. | .. | .. | 293.20             |
| B                                   | .. | .. | .. | .. | .. | .. | 279.79             |
| E                                   | .. | .. | .. | .. | .. | .. | 272.39             |
| C                                   | .. | .. | .. | .. | .. | .. | 265.07             |
| F                                   | .. | .. | .. | .. | .. | .. | 259.05             |
| G                                   | .. | .. | .. | .. | .. | .. | 236.18             |
| 5 per cent Significant difference   | .. | .. | .. | .. | .. | .. | 68.35              |
| 1 per cent Significant difference   | .. | .. | .. | .. | .. | .. | 91.45              |
| 0.1 per cent Significant difference | .. | .. | .. | .. | .. | .. | 120.10             |

Although results are significant, only one family (A) yielded better than Yandev Unselected at the 5 per cent point. When these yields are considered in relation to earliness, it can be seen that the highest yielding family was the latest to reach maturity (Table 14).

The following "percentage maturities" were obtained for the various families, and they were transformed for analysis by using Fisher and Yates "Angular Transformation" of percentages to degrees.

TABLE 14

#### BENNISEED SELECTIONS ARRANGED IN ORDER OF MATURITY

| <i>Family</i>                          |    |    |    | <i>Percentage<br/>mature<br/>plants</i> | <i>Percentage<br/>transformed<br/>to degrees</i> | <i>Average No. of<br/>days to full<br/>maturity</i> |
|----------------------------------------|----|----|----|-----------------------------------------|--------------------------------------------------|-----------------------------------------------------|
| F                                      | .. | .. | .. | 47.5                                    | 43.6                                             | 99.2                                                |
| B                                      | .. | .. | .. | 42.0                                    | 40.4                                             | 92.2                                                |
| C                                      | .. | .. | .. | 21.3                                    | 27.5                                             | 94.6                                                |
| J                                      | .. | .. | .. | 11.9                                    | 20.2                                             | 96.9                                                |
| D                                      | .. | .. | .. | 11.7                                    | 20.0                                             | 96.6                                                |
| H                                      | .. | .. | .. | 11.3                                    | 19.7                                             | 93.3                                                |
| E                                      | .. | .. | .. | 10.7                                    | 19.1                                             | 97.5                                                |
| G                                      | .. | .. | .. | 10.4                                    | 18.8                                             | 97.0                                                |
| A                                      | .. | .. | .. | 6.8                                     | 15.1                                             | 98.0                                                |
| U                                      | .. | .. | .. | 2.6                                     | 9.2                                              | 104.0                                               |
| Significant difference at 5.0 per cent | .. | .. | .. | ..                                      | ..                                               | 13.5                                                |
| Significant difference at 1.0 per cent | .. | .. | .. | ..                                      | ..                                               | 18.1                                                |
| Significant difference at 0.1 per cent | .. | .. | .. | ..                                      | ..                                               | 23.8                                                |

It is clear from the above figures that the characteristic of earliness is being maintained by some of our new strains. On the basis of percentage of mature plants, families F and B have done very well. The latter reached full maturity in about 92 days compared with 104 for the Unselected Yandev seed. This difference of 12 days can be of great value in Benue Province where it is essential that the plants mature in the "short dry" season. It is particularly useful when a late start in the rains necessitates later than normal planting.

Analysis of earliness within families was also carried out and results indicate a significant difference between strains in families B, F, G, H and J.

As a whole, it is considered that results to-date have justified this breeding programme. The work will continue and it is hoped that in due course, strains will be obtained which combine the desirable characteristics of earliness and high yielding capacity.

As a result of the selection work on benniseed, high yielding strains have been collected and a few of these have maintained this desirable character since 1949. It was decided, therefore, to place two of these strains in a small replicated trial to compare them with Yandev Unselected seed.

The following results were obtained :—

|            |    |    |    |    |    |    |                 |
|------------|----|----|----|----|----|----|-----------------|
| Strain 055 | .. | .. | .. | .. | .. | .. | 501 lb per acre |
| Strain 064 | .. | .. | .. | .. | .. | .. | 453 lb per acre |
| Unselected | .. | .. | .. | .. | .. | .. | 428 lb per acre |

Although results were statistically insignificant, there is a trend in favour of the selected strains. The trial will be repeated in 1953.

#### SUNFLOWER

(*Helianthus annuus*)

##### Variety Yield Trial—A12 (52)

This experiment compared four introduced varieties with the common grey seeded strain. Significant results were obtained as shown below. Grey seeded was the heaviest yielder and Saturn is the best of the introduced varieties.

TABLE 15  
YIELDS OF SUNFLOWER IN LB PER ACRE THRESHED SEED

| Variety               | 1950  | 1951  | 1952  | Average |
|-----------------------|-------|-------|-------|---------|
| Grey Seeded .. ..     | 983   | 1,147 | 1,033 | 1,054   |
| Saturn .. ..          | 1,049 | 846   | 909   | 935     |
| Hungarian .. ..       | 898   | 406   | 594   | 633     |
| Advanced Hybrid .. .. | —     | 330   | 506   | 418     |
| Sunrise .. ..         | 513   | 165   | 378   | 352     |

Significant difference at 1.0 per cent .. 230

Significant difference at 5.0 per cent .. 168

*Maintenance.*—It has been found necessary to grow sunflowers in isolation plots to maintain their purity. Selfing has been tried with baft cotton bags, using “clean bees” as pollinating agents. This has not been successful as most of the resultant seeds are empty. Considerable difficulty has been experienced in finding a sufficient number of isolation plots due to the concentrated area under cultivation at Samaru and the cropping schedules of other sections on the station.

#### TOBACCO

(*Nicotiana tabacum*)

The Nigerian Tobacco Company has again assisted us in conducting a tobacco variety trial. Experiment A13 (52) contained five new varieties from the Nigerian Tobacco Company and six selections of Virginia Hybrid from Gusau.



The excessive rains of July caused much water-logging and the trial was not a success. Size of leaf was small but a greater quantity of leaves was harvested than had been expected. The tobacco is at present being cured and no final results are yet available. In 1953, a similar experiment will be planted on an upland field where it is hoped that water-logging will be avoided.

## CASSAVA

(*Manihot utilissima* and *M. palmata*)

### *Effect of Mosaic on Yield—A11 (51)*

This experiment is part of a series of trials begun in 1949 to determine the effect of mosaic on yield. This year's results were statistically insignificant but the trend established in 1950-51 was maintained. The 1949-50 trial was a failure due to lack of planting material. Previous to 1949 a trial had been conducted using "clean" Dan Warri from Samaru compared with infected Dan Warri from Zonkwa, (A2 (48)). The results were significantly in favour of the clean Samaru Dan Warri but no conclusions could be drawn as the Zonkwa strain may not have been identical to that grown at Samaru. The 1949 trial was therefore designed to include Samaru Dan Warri multiplied up from plants which became infected during the 1948 trial.

The following table compares yields obtained in 1949, 1951 and 1952 (*i.e.*, from the 1948, 1950 and 1951 trials).

TABLE 16

YIELDS OF CASSAVA IN LB TUBERS PER ACRE FROM HEALTHY AND MOSAIC INFECTED SOURCES

|                                           | 1949   | 1951   | 1952   |
|-------------------------------------------|--------|--------|--------|
| Infected Dan Warri <i>ex</i> Zonkwa .. .. | 7,020  | 12,849 | 12,633 |
| Clean Dan Warri <i>ex</i> Samaru .. ..    | 10,390 | 11,873 | 12,300 |
| Infected Dan Warri <i>ex</i> Samaru .. .. | —      | 10,966 | 11,000 |
| Significant difference 1 per cent .. ..   | 2,101  | N. S.  | N. S.  |

Although no significant results were obtained in 1951 and 1952, there appears to be a trend in favour of Clean Samaru Dan Warri when compared with infected material of the same strain, the yield difference being of the order of 1,000 lb per acre (about 10 per cent).

### *Variety Yield Trial—A12 (51)*

Fifteen varieties were tested in a yield trial with results shown in Table 17. The varieties, except for CH 28, Dan Warri and Two Cent, were clones of open pollinated seedlings grown in 1946. Code letters of the female parents of these clones are as follows :—

- A—Maiduguri Dan Warri
- B—Ibadan GC 997B
- C—Ibadan C/36/95
- E—Ibadan CH 28
- H—Minna GC 997B

TABLE 17

SHOWING YIELDS IN LB TUBERS PER ACRE, OBTAINED IN 1951 AND 1952 HARVESTS OF  
CASSAVA VARIETY YIELD TRIAL

| "Variety" or Clone                | A8 (50) | A12 (51) | Average |
|-----------------------------------|---------|----------|---------|
| "CH 50" .. .. .                   | 13,407  | 19,219   | 16,313  |
| B 18 .. .. .                      | 10,959  | 17,451   | 14,205  |
| "Dan Warri" .. .. .               | 8,857   | 19,421   | 14,139  |
| E 2 .. .. .                       | 12,944  | 13,807   | 13,375  |
| C 15 .. .. .                      | 13,309  | 13,161   | 13,235  |
| B 17 .. .. .                      | 12,715  | 12,678   | 12,696  |
| C 5 .. .. .                       | 9,843   | 14,828   | 12,335  |
| "Two Cent" .. .. .                | 10,794  | 13,398   | 12,096  |
| B 21 .. .. .                      | 8,107   | 7,323    | 11,650  |
| H 1 .. .. .                       | 6,001   | 15,193   | 10,597  |
| "CH 28" .. .. .                   | 8,519   | 11,504   | 10,011  |
| C 23 .. .. .                      | 3,011   | 11,386   | 7,198   |
| B 9.. .. .                        | 5,000   | 4,593    | 4,786   |
| B 26 .. .. .                      | —       | 7,480    | (7,480) |
| A 2.. .. .                        | —       | 5,428    | (5,428) |
| Significant difference 5 per cent | 4,756   | 5,901    |         |
| .. .. . 1 per cent                | 6,422   | 7,860    |         |

The only conclusion that can be drawn, so far, is that B 9, B 26 and A 2 are not satisfactory yielders. None of the clones appears likely to out-yield CH 50 or Dan Warri.

#### *Length of Planting Material*

Observation tests were made on cuttings of mosaic infected Dan Warri from Zonkwa. The stems were cut into lengths of 6 inches, 9 inches, 12 inches and 15 inches. The yields recorded from these different sets of planting material, respectively, are shown in Table below :

| Length of Planting Material<br>(Inches) | Yield of Tubers per acre<br>(pounds) |
|-----------------------------------------|--------------------------------------|
| 15 .. .. .                              | 12,958                               |
| 12 .. .. .                              | 13,613                               |
| 9 .. .. .                               | 8,873                                |
| 6 .. .. .                               | 12,806                               |

These results are not conclusive, but it would appear that 12 inches lengths give the best results. No explanation is offered for the discrepancy between 9 inches and 6 inches lengths. The trial is being repeated. The question is of importance because in the North, the above-ground growth of cassava is much less than in the South. Consequently, the multiplication of a variety tends to be slower in Northern Nigeria. Therefore, it is desirable to use the minimum length of planting material that will be satisfactory.

#### PASTURE WORK

The Pasture Section of the Northern Research Station was established during the year under review. Previously, pasture and grassland work has suffered through lack of co-ordination and direction.

The collections of forage crops at Samaru and Shika are to be considerably enlarged by introductions from other countries.

Consideration is being given to both ley-farming and to the improvement of natural grass-land.



# BOTANICAL WORK IN THE SOUTH

## STAFF

|               |                                    |
|---------------|------------------------------------|
| T. A. Russell | <i>Senior Botanist</i>             |
| A. J. Vernon  | <i>Botanist</i>                    |
| C. A. Thorold | <i>Plant Pathologist</i>           |
| A. O. Bamtefa | <i>Agricultural Superintendent</i> |

## INTRODUCTION

The work of the Botany Section in the South, centred at Moor Plantation, Ibadan, continued along the lines of previous years, aiming generally at the improvement of crop-plants for the Western and Eastern Regions. Mr A. J. Vernon, Agricultural Botanist, worked on annual food-crops while Mr T. A. Russell, Senior Botanist, was chiefly concerned with the perennial crops and the administration of the Section.

While, for convenience of staffing, most of the work was done in the West at Ibadan, the needs of the Eastern Region were by no means neglected. Part of the programme on food-crops, including some work on maize, cowpeas, cassava and yams was done at Umuahia and Abak under supervision of an Assistant.

The Senior Botanist spent a month in the Eastern Region during November and December when several provinces were visited.

The weather at Ibadan was abnormal in few respects. Good rains came early in March 1952 and enabled the planting of annual crops sooner than usual. Rainfall from April to July was heavy and there was then a well-marked short dry season in August. The rains were resumed in September and October but stopped abruptly in the first week of November, after which there was no rain until late in February when heavy showers fell. The rainfall for the calendar year 1952 of 49.73 inches is slightly above the mean figure for the previous ten years of 46.94 inches. Although practically rainless, the dry season was unusual in that the dry harmattan wind was hardly felt in Ibadan, and the permanent crops showed less signs of drought than is often the case.

## RAINFALL, MOOR PLANTATION, IBADAN, 1952

| <i>Month</i>    | <i>Inches</i> | <i>Wet days</i> | <i>Cumulative Total Inches</i> | <i>Previous Average (10 years) Inches</i> | <i>Cumulative Total</i> |
|-----------------|---------------|-----------------|--------------------------------|-------------------------------------------|-------------------------|
| January .. ..   | 0.00          | 0               | 0.00                           | 0.44                                      | 0.44                    |
| February .. ..  | 1.58          | 4               | 1.58                           | 0.61                                      | 1.05                    |
| March .. ..     | 4.39          | 7               | 5.97                           | 2.11                                      | 3.16                    |
| April .. ..     | 6.03          | 7               | 12.00                          | 5.41                                      | 8.57                    |
| May .. ..       | 7.86          | 16              | 19.86                          | 6.42                                      | 14.99                   |
| June .. ..      | 7.48          | 19              | 27.34                          | 6.49                                      | 21.48                   |
| July .. ..      | 7.56          | 19              | 34.90                          | 5.57                                      | 27.05                   |
| August .. ..    | 0.75          | 6               | 35.65                          | 3.38                                      | 30.43                   |
| September .. .. | 4.83          | 22              | 40.48                          | 7.65                                      | 38.28                   |
| October .. ..   | 6.49          | 19              | 46.97                          | 6.80                                      | 45.08                   |
| November .. ..  | 2.69          | 5               | 49.66                          | 1.62                                      | 46.70                   |
| December .. ..  | 0.07          | 1               | 49.73                          | 0.24                                      | 46.94                   |
| Total .. ..     | <u>49.73</u>  | <u>125</u>      | <u>49.73</u>                   | <u>46.94</u>                              | <u>46.94</u>            |

Rainfall at the Eastern Research Station is given for comparison :—

RAINFALL, UMUAHIA (UMUDIKE), 1952

| <i>Month</i> |    |    | <i>Inches</i> | <i>Wet days</i> | <i>Cumulative Total Inches</i> | <i>Previous Average (18 years) Inches</i> | <i>Cumulative Total</i> |
|--------------|----|----|---------------|-----------------|--------------------------------|-------------------------------------------|-------------------------|
| January      | .. | .. | 1.60          | 3               | 1.60                           | 0.91                                      | 0.91                    |
| February     | .. | .. | 0.56          | 3               | 2.16                           | 1.88                                      | 2.79                    |
| March        | .. | .. | 2.02          | 8               | 4.18                           | 4.36                                      | 7.15                    |
| April        | .. | .. | 5.62          | 11              | 9.80                           | 7.82                                      | 14.97                   |
| May ..       | .. | .. | 10.28         | 21              | 20.08                          | 10.23                                     | 25.20                   |
| June ..      | .. | .. | 9.65          | 24              | 29.73                          | 11.86                                     | 37.06                   |
| July ..      | .. | .. | 10.43         | 29              | 40.16                          | 11.59                                     | 48.65                   |
| August       | .. | .. | 11.00         | 28              | 51.16                          | 10.17                                     | 58.82                   |
| September    | .. | .. | 14.01         | 25              | 65.17                          | 13.36                                     | 72.18                   |
| October      | .. | .. | 5.51          | 25              | 70.68                          | 11.22                                     | 83.40                   |
| November     | .. | .. | 1.22          | 7               | 71.90                          | 3.34                                      | 86.74                   |
| December     | .. | .. | 0.00          | 0               | 71.90                          | 0.75                                      | 87.49                   |
| Total        | .. | .. | 71.90         | 184             | 71.90                          | 87.49                                     | 87.49                   |

PERMANENT CROPS—T. A. RUSSELL

*Cacao*.—The results of a spacing-trial during the first nine years from planting have been written and submitted for publication. In the tenth year now completed, the previous results were confirmed in that no significant difference in yield per acre was shown between the four closest spacings at 5 by 5 feet, 6 by 6, 6 by 7½, and 7½ by 7½ feet. All of these were significantly higher yielding than the wider spacings. In this year, loss of pods from *Phytophthora* rot became heavy for the first time and seriously reduced the yields from all treatments, without altering the significance of the results.

The hybrid seedlings, progeny of the Nigerian selection T38 crossed with high-yielding Trinidadian parents (whose earlier performance was described in an article in *Tropical Agriculture*, 1952 Volume 29) continued to give high yields in their tenth year from planting. The superiority of the hybrids over the local selection was however less marked than in previous years. Their performance is shown in the following table, expressed as yield of dried beans per acre, this being taken as 42 per cent of the wet bean weight. In this trial also, yields were considerably reduced by *Phytophthora* pod-rot.

TABLE 18  
YIELD OF NINE TYPES OF CACAO SEEDLINGS IN THE TENTH YEAR AFTER PLANTING

| <i>Type of Seedlings</i> |                                       |    |    | <i>Calculated Weight of dried beans in lb per acre</i> |
|--------------------------|---------------------------------------|----|----|--------------------------------------------------------|
| G                        | Nigerian T38 x Trinidad seedling T1.. | .. | .. | 1,218                                                  |
| J                        | Nigerian T38 x Trinidad seedling T3.. | .. | .. | 1,145                                                  |
| H                        | Nigerian T38 x Trinidad seedling T2.. | .. | .. | 1,018                                                  |
| D                        | Nigerian selection T38 selfed (F1)    | .. | .. | 865                                                    |
| E                        | Nigerian selection selfed twice (F2)  | .. | .. | 792                                                    |
| F                        | Nigerian selection selfed twice (F2)  | .. | .. | 491                                                    |
| C                        | Trinidad seedling T3 selfed           | .. | .. | 797                                                    |
| B                        | Trinidad seedling T2 selfed           | .. | .. | 728                                                    |
| A                        | Trinidad seedling T1 selfed           | .. | .. | 419                                                    |

At Agodi Cocoa Farm, the mean weight of air-dried cocoa beans was measured from each three-weekly harvesting throughout the year. It was found that the mean weight of 300 beans ranged from as low as 8.6 oz in early May to a maximum of 13.4 oz in mid-September. Standard-weight cocoa weighing 11 oz or more per 300 beans was obtained as early in the season as the first week in July and continued until the second half of January.

Investigation was continued into the disease of cacao at Kake near Kumba in the Cameroons which is characterised by marginal chlorosis of the leaves and of tissues adjacent to the secondary veins. Originally suspected of being of virus cause, the disease has not so far proved to be transmissible by grafting. Buds from diseased plants grafted on healthy seedlings have grown out without showing symptoms. The possibility of a nutritional disorder is being explored and in preliminary tests there was some indication of improvement by the injection of copper. More critical tests are required to be made before a conclusion can be reached.

Introductions of useful cacao clones continued to be made through plant quarantine at Kew and Accra. These included some of the outstanding Imperial College Selections from Trinidad, two Upper Amazon varieties, and the Trinitario selection TF1 from the Gold Coast, obtained through the kindness of the Professor of Botany, Imperial College of Tropical Agriculture; the Director, Royal Botanic Gardens, Kew; and the Director of Cacao Research, Tafo.

During the year, planting-material was prepared and grown by the Botany Section in quantity for the Western Regional Production Development Board and for Departmental use in the Western and Eastern Regions.

*Kola*.—Observations were maintained on the yields of individual kola-trees and their flowering and fruiting behaviour. The information obtained should soon enable high-yielding trees of good quality to be selected for the improvement of this valuable West African crop.

*Rubber*.—A collection of outstanding clones of *Hevea* rubber was started during the year under review with the object of having a Departmental nursery from which good planting-material can be distributed. The most useful contribution was a consignment of eight clones sent by the Director, Rubber Research Institute of Malaya, including some of the best of the "500" series.

*Citrus*.—The trial of suitable rootstocks for grapefruit and for orange planted in 1931 have shown a notable decline in yield in the last two years. It seems evident that under the local conditions of soil and cultivation when no fertilizers are used, the profitable life of budded citrus is less than twenty years.

While sour orange has hitherto proved a satisfactory rootstock for sweet orange, its general use is no longer recommended in view of its susceptibility to *tristeza*, a disease which has been shown to occur in other parts of West Africa, though not yet reported in Nigeria. In order to find new rootstocks equally useful but more tolerant of *tristeza* attack, a new rootstock trial has been planted. Varieties under test as rootstocks for sweet orange include Cleopatra mandarin and Sampson tangelo as well as sour orange, sweet orange, and rough lemon.

In the Eastern Provinces the assistance of the extension staff has been obtained in selecting seedling trees of Nigerian sweet orange of outstanding merit in their areas. Budwood from these trees is being sent to Umudike, to form a collection for further selection.

#### ARABLE CROPS—A. J. VERNON

As in the previous year, priority was given to maize work, since it was thought that the prospects of obtaining useful results quickly were greatest with that crop.

*Maize—Variety trials*.—The promising results of the 1951 variety trial were followed by three variety trials in the Ibadan early season (twenty-seven varieties tested), two trials (twenty-six varieties tested) in the Ibadan late season, and one trial of six varieties at Umuahia. These trials were laid out as randomised blocks, in some cases with split plots, two spacings being used. A higher standard of accuracy was achieved than in 1951. Some yields from these trials are shown in the table.



TABLE 19

SHOWING YIELDS OF MAIZE IN POUNDS OF DRY GRAIN PER ACRE ACCORDING TO VARIETY  
AND DATE OF PLANTING

| Planting Date               | Ibadan Early Season |       |       | Umuahia |                                     | Ibadan Late Season |         |
|-----------------------------|---------------------|-------|-------|---------|-------------------------------------|--------------------|---------|
|                             | 7/4                 | 17/4  | 22/4  |         |                                     | Trial A            | Trial B |
| American Bounty .. ..       | —                   | 1,490 | 1,120 | 440     | Bounty {<br>White<br>Yellow<br>Late | 1,060              | 1,230   |
| Tsolo .. ..                 | 1,030               | 1,400 | 1,300 | 430     |                                     | 890                | 1,400   |
| Akure Selection .. ..       | 1,090               | 1,440 | 990   | —       |                                     | 990                | 1,310   |
| Big Joe .. ..               | —                   | 1,240 | —     | —       |                                     | —                  | 1,100   |
| White Tuxpan .. ..          | —                   | —     | 820   | —       |                                     | —                  | 1,120   |
| Lagos White .. ..           | 600                 | 1,100 | 700   | 150     |                                     | 716                | 1,090   |
| Average of Local Variety .. | 600                 | 700   | 600   | 260     |                                     | 440                | 940     |
| Sig. Diff. at 5 per cent .. | 200                 | 280   | 170   | 110     |                                     | 140                | 720     |
|                             |                     |       |       |         |                                     |                    | 230     |

The Akure selection was thought at the time to be local material, but a later check revealed that some Tsolo maize had previously been grown at Akure Government Farm. The success of the Akure selection is almost certainly attributable to this Tsolo "blood". There were no successful new varieties in replicated trials, but in the collection plots, Sicaragua (*ex* Venezuela) and several of the lines newly obtained from Mexico, appeared most promising. The open pollinated variety Cuba Amarillo and the partially inbred Mexico 16 and 17 appeared almost immune to rust, *Puccinia polysora*.

The failure of American White Flint to repeat its 1951 performance was disappointing, but the success of the Bounty lines (derived from American Bounty, bred at Ibadan in 1951) was encouraging. It was decided that the following varieties could be taken as proved to be superior yielding to local varieties at Ibadan:—

|                     | Maturity |    |        | Type |    |                          |
|---------------------|----------|----|--------|------|----|--------------------------|
| White Bounty .. ..  | ..       | .. | Medium | ..   | .. | white intermediate       |
| Yellow Bounty .. .. | ..       | .. | Medium | ..   | .. | yellow intermediate      |
| Late Bounty .. ..   | ..       | .. | Medium | ..   | .. | pale yellow intermediate |
| Big Joe .. ..       | ..       | .. | Medium | ..   | .. | yellow dent              |
| Tsolo .. ..         | ..       | .. | Medium | ..   | .. | yellow flint             |
| White Tuxpan .. ..  | ..       | .. | Late   | ..   | .. | white dent               |

The next step is to test these over the whole of southern Nigeria against appropriate local varieties in each district. Owing to the great variation in yield of local varieties, no definite figure can be given for increases in yield obtained at Ibadan, but the range of increase is approximately from 25 per cent to 100 per cent.

*Maintenance and Breeding.*—By the end of the second season over 100 varieties were being maintained by hand-pollination and isolation plot techniques. The programme on the Tsolo and Lagos White selfed lines was continued with the yield testing of over 100 S<sup>1</sup> lines and the combination of the best Tsolo S<sup>1</sup> lines into a synthetic. Selfing to give S<sup>2</sup> lines was also done. The breeding programme was limited to this, as it was desired to examine the possibilities of Mexican material before embarking on more extensive work. It now appears that in Mexico 16 and 17 and to a lesser extent in Mexico 1, 2, and 13, Sicaragua, and Mauritius, and even less so in the Bounty types, Big Joe, Tsolo, and White Tuxpan, there is available a range of rust-resistant material from which it should be possible to breed highly resistant, good yielding varieties.

To expedite the work on these promising varieties, a number of multiplication and breeding plots were sown in the dry season. Sufficient success was obtained with these to show that for some multiplication and breeding purposes three maize crops can be taken in one year at

Ibadan. During November and December, breeding and maintenance of collections were handed over to the Maize Rust Research Unit, with the exception of those varieties which are in large-scale production for yield trials.

*Pathology.*—An improved method of scoring attack of maize rust was devised, for use in experimental work at Ibadan and for a maize rust survey of Nigeria. This survey was carried out with the co-operation of provincial agricultural staff during 1952, and the results passed to the Maize Rust Research Unit in December. In addition to scoring all variety trials and collections for intensity of rust attack, two special investigations were made. In one case an attempt was made to measure loss in yield due to rust by using sulphur-dusted plots as a control. In the other, the object was to show how planting date affects degree of infection. Although heavy dressings of sulphur were applied, only a slight degree of control was obtained, but the increases in yield were striking, as shown in Table 20 below. At each stage the difference is significant at 1 per cent level.

TABLE 20

SHOWING RECORD OF MAIZE RUST SCORES AT VARIOUS INTERVALS IN RELATION TO TREATMENT OF PLANTS WITH SULPHUR

|                |    |    |    |    | 45 days | 60 days | 75 days | 90 days |
|----------------|----|----|----|----|---------|---------|---------|---------|
| Untreated      | .. | .. | .. | .. | 0.8     | 4.0     | 6.6     | 7.6     |
| Sulphur dusted | .. | .. | .. | .. | 0.2     | 2.8     | 5.3     | 6.9     |

Yields shown as the average of six plots, adjusted to pounds of dry grain per acre were :—

|                |    |    |                 |                                    |
|----------------|----|----|-----------------|------------------------------------|
| Untreated      | .. | .. | 317 lb per acre |                                    |
| Sulphur dusted | .. | .. | 562 lb per acre | S.E. of difference=38 lb per acre. |
| Increase       | .. | .. | 245 lb per acre |                                    |

The figures from the planting date experiment were also conclusive, showing that later planting seriously increases degree of infection.

TABLE 21

SHOWING RECORD OF MAIZE RUST SCORES AT VARIOUS INTERVALS IN RELATION TO SOWING DATE

| Sowing Date   | Rust Score at |         |         |         |
|---------------|---------------|---------|---------|---------|
|               | 42 days       | 56 days | 70 days | 84 days |
| 23rd February | ..            | ..      | ..      | 0       |
| 8th March     | ..            | ..      | ..      | 0       |
| 22nd March    | ..            | ..      | ..      | 0       |
| 5th April     | ..            | ..      | ..      | 0       |
| 19th April    | ..            | ..      | ..      | 0       |
|               | 0             | 1.6     | 5.1     | 7.6     |
|               | 0             | 3.6     | 6.5     | 6.9     |
|               | 2.3           | 4.3     | 5.3     | 8.0     |

*Cowpeas.*—At Ibadan, a special layout was used which would give the greatest precision to varietal comparisons and interactions involving varieties, and less precision to other main effects and their interactions. A trial of six cowpea varieties at three spacings and three sowing dates, sole cropped and intercropped with maize, was conducted during the late season.

A high standard of precision was achieved, in some comparisons a difference of 30 lb per acre (*i.e.*, 5 per cent) being significant. Among the outstanding features of the results, the one of greatest practical importance was that the cowpeas intercropped gave as good or higher yields than those grown alone. There was also evidence that the maize yields, which averaged about 1,000 lb per acre, were nearly as great as would be given by sole cropped maize. There would appear to be little advantage in growing either late maize or cowpeas as a sole crop, unless it is desired to rest the land from one or the other of these crops, or because mechanisation demands it.

The best sole-crop yield was obtained from New Era (C1346) sown in mid-August at 3 feet by 4 feet spacing which gave 890 lb dry grain per acre. In terms of total yield of dry grain this was beaten by almost all the intercrop treatments, the best of these being New Era

early sown close spacing, which gave 770 lb per acre cowpeas, plus 990 lb per acre maize, totalling 1760 lb dry grain per acre. Relative performances of these varieties are shown in the following table :—

TABLE 22

COWPEA YIELDS EXPRESSED AS POUNDS OF DRY GRAIN PER ACRE, SOWN 13TH AUGUST, AND OBTAINED FROM AN AVERAGE OF THREE SPACINGS, BOTH AS A SOLE CROP AND INTERCROPPED WITH MAIZE AT IBADAN

| <i>Variety</i>  |  | <i>New Era</i> | <i>Mauritius</i> | <i>Machakos</i> | <i>Icta 186</i> | <i>1st Local</i> | <i>2nd Local</i> |
|-----------------|--|----------------|------------------|-----------------|-----------------|------------------|------------------|
| Sole Cropped .. |  | 812            | 657              | 325             | 238             | 224              | 178              |
| With Maize ..   |  | 689            | 619              | 322             | 238             | 235              | 211              |

S.E. of difference between yields was 30 lb per acre.

Thus it now appears certain, in spite of contrary results in some past seasons, that the quick maturing varieties of cowpea, such as New Era and Mauritius (C70), under normal conditions of Ibadan climate and cropping, are far higher yielders than the slow maturing Machakos (C60) and Icta 186. Results suggest that these latter may be more adapted to conditions of uniform low rainfall such as may be experienced at Ibadan in November to January in some seasons, though a fairly abrupt change from heavy rainfall to complete drought is more common. Under these conditions, the long maturing varieties may fail completely and this eventuality cannot be counteracted by earlier sowing which depresses yields of slow maturing varieties in wet seasons. It is in favour of the long maturing varieties that their harvest may be staggered over several months, when other fresh food is scarce. If the harmattan is not too severe, and if some rain falls in late December or January, picking can continue until March. New Era on the other hand gives its best yield in a short spell at the end of the rains, which is advantageous in large scale mechanised farming, but not suitable to a subsistence farmer. New Era is the best variety available now with Mauritius as second choice. Future breeding will explore two lines :— (a) the development of New Era for mechanisation by shortening its already brief harvest period, (b) improving the yield of a long maturing cowpea with the drought resistance and persistence of Machakos.

The trial clearly demonstrated that spacings and sowing dates interacted with each other, as well as with varieties and mode of cropping. In general, wide spacings tend to do best at early sowing dates of sole cropped cowpeas. For later sowing dates, and more particularly for the intercrop, closer spacings are better, as shown in the following table.

TABLE 23

AVERAGE YIELD OF SIX COWPEA VARIETIES IN POUNDS OF DRY GRAIN PER ACRE AT DIFFERENT SOWING DATES AT IBADAN

|                  |    | <i>Sole cropped</i> |         |          | <i>Intercropped with Maize at<br/>2 feet by 4 feet</i> |         |          |
|------------------|----|---------------------|---------|----------|--------------------------------------------------------|---------|----------|
| Date of sowing   |    | Aug. 13             | Aug. 27 | Sept. 17 | Aug. 7                                                 | Aug. 27 | Sept. 17 |
| 3 feet by 4 feet | .. | 470                 | 460     | 380      | 420                                                    | 290     | 150      |
| 2 feet by 4 feet | .. | 450                 | 400     | 380      | 380                                                    | 310     | 220      |
| 1 foot by 4 feet | .. | 300                 | 380     | 330      | 330                                                    | 320     | 300      |

The figures are averages of varieties and the S.E. of a difference varies according to which comparison is being made. The maximum is 55 lb per acre.

Unfortunately, although this overall picture is fairly consistent for five of the varieties, the figures for New Era showed considerable deviations from the general trend. These deviations may be due to error, but further work is needed before confident recommendations are made regarding spacings, particularly in view of the need to explore different combinations of maize and cowpea spacings in the intercrop and conflicting results which have been obtained at Umuahia.



Results obtained in the Eastern Region at Umuahia show little or no agreement with those at Ibadan except in so far as New Era and Mauritius have always done well in trials in both Regions. There is no cowpea grown locally at Umuahia, therefore, an Onitsha variety has been used as a control in several trials. In previous years it had always performed worse than most of the imported varieties, particularly the two mentioned above, but results of the 1952 trial, the first at Umuahia to incorporate a range of spacings and sowing dates, suggest the possibility that later than optimum sowing dates may have been largely responsible for this.

TABLE 24

1952 COWPEA TRIAL, UMUAHIA—YIELDS ADJUSTED TO POUNDS OF DRY GRAIN PER ACRE, FOR VARIETIES AT DIFFERENT SPACINGS AND SOWING DATES

| Sowing Date   | .. | .. | .. | August 14    |                 | September 11   |                |
|---------------|----|----|----|--------------|-----------------|----------------|----------------|
| Spacing       | .. | .. | .. | 3 ft by 4 ft | 1½ ft. by 4 ft. | 3 ft. by 4 ft. | 1½ ft. by 4 ft |
| Mauritius     | .. | .. | .. | 490          | 820             | 210            | 190            |
| Tabora (725)  | .. | .. | .. | 560          | 750             | 260            | 210            |
| Onitsha Small | .. | .. | .. | 520          | 730             | 140            | 130            |
| Hondoi Brown  | .. | .. | .. | 540          | 710             | 270            | 250            |
| Nhemba        | .. | .. | .. | 500          | 690             | 290            | 270            |
| New Era       | .. | .. | .. | 470          | 600             | 210            | 210            |

The Standard error of a treatment mean is 40 lb per acre. New Era suffered from poor germination which largely accounts for its relatively small yield.

The yield of 730 lb per acre from "Onitsha small" is the highest yet obtained in Botany Section trials for a local variety and represents an unexpected challenge to the imported varieties. However, taking previous results into account, it would appear that Mauritius, and possibly New Era also are to be recommended for Umuahia.

Regarding the effects and interaction of different spacings and sowing dates it should be noted that at Umuahia, as at Ibadan, early sowing is best, but at the earlier sowing the close spacing is better whilst at the later sowing the converse is true. This interaction (highly significant statistically) is exactly the reverse of that experienced in two trials at Ibadan. In view of the considerable yield differences involved (up to 50 per cent in some cases) further investigation must be made.

*Cassava*.—The 1951-52 main cassava variety trial harvested in May 1952 was a failure, owing to a very poor stand obtained in one block which followed newly turned-in Centrosema. Excessive termite activity appeared to be the cause of damage. The layout was a twenty-five treatment lattice square with only three replications, and the low number of replications proved a serious fault. A subsidiary cassava variety trial included only G.C.H. 7 (a re-numbering of GC997B) and the local Karagba, the latter being a freshly taken sample from local farms. The results are summarised below :—

| Variety                                    |    |    |    |    | Yield             |
|--------------------------------------------|----|----|----|----|-------------------|
| Karagba                                    | .. | .. | .. | .. | 5.7 tons per acre |
| GCH7                                       | .. | .. | .. | .. | 4.2 tons per acre |
| Significant difference at 1 per cent point | .. | .. | .. | .. | 0.7 tons per acre |

It appears that the superior yielding ability of this Gold Coast hybrid has now dropped below that of the local variety through mosaic disease infection.

*Other Crops*.—Collections of yams and edible legumes were maintained at Umuahia, and collections of legumes and sweet potatoes at Ibadan. Simplification of the Umuahia yam collection was instituted. The cotton programme at Ibadan continued as in previous years.

*Plant Exchange*.—Amongst a wide range of useful plants introduced, were numerous kinds of maize from different parts of the world for work on the improvement of this crop. Of particular interest was a collection from Mexico, of which some varieties show high resistance

to maize rust, *Puccinia polysora*. Also of interest were sugarcane varieties brought in from South Africa, Barbados, India and Pakistan, in the search for resistance to red-rot, *Colletotrichum falcatum*, which is destructive on cane in the Northern and Eastern Regions of Nigeria.

## PLANT PATHOLOGY—C. A. THOROLD

### BLACK-POD DISEASE OF COCOA

The duties of the Plant Pathologist have continued to be concerned mainly with black-pod (*Phytophthora palmivora*) disease of cocoa.

Two possible methods for combatting black-pod disease have now been tried on the field scale, these trials have provided information on the economics of control measures.

Concurrently with the investigation of methods for control of black-pod, more fundamental studies have been continued. Consequently, there is reason to believe that recommendations for controlling the disease are based on fairly adequate knowledge of the fungus and its behaviour. Nevertheless, certain aspects of the problem require further attention, particularly as regards the manner in which the fungus survives the dry season.

Small-scale plot experiments at Owena, near Ondo, carried out for two seasons, had shown that applications of either Carbide-Bordeaux mixture (1 per cent) or "Perenox" (0.2 per cent) could give satisfactory control of black-pod. It was desirable, therefore, to enlarge the scale of these experiments, in order to test fungicide control on cocoa farms.

Arrangements were made with the helpful participation of the Registrar of Co-operative Societies, for the use of a group of cocoa farms at Aponmu, in Ondo Province. Certain members of the Aponmu Co-operative Society generously allowed their farms to be used for the trials.

It was desirable to compare fungicide application with the control method which is generally recommended. It has been shown that black-pod losses can be reduced by the procedure of inspecting cocoa trees every other day for the purpose of removing black-pods, in the earliest visible symptom stage. The first indication that a pod is infected is the appearance of a small brown spot on the surface of the pod. On the succeeding day this spot enlarges, but on the third day sporangia are present. It is important that the pod should be removed on either the first or second day, which should be achieved through inspection every other day. When there is a longer interval between inspection rounds, there is a likelihood of healthy pods becoming infected during this period, because, as explained above, sporangia production starts after the brown spot has been visible for two days.

Other considerations have indicated that the method of control by regular inspection of trees for the removal of pods in the earliest symptom stage, will be particularly effective in the case of low-yielding trees which produces eleven or fewer pods during the season.

On the other hand, spraying is likely to be uneconomical except for relatively high-yielding trees, giving more than eleven pods per tree. The average yield at Aponmu in 1952 was about fourteen pods per tree. Therefore, this area was suitable for black-pod control by spraying rather than for regular inspection of trees with removal of infected pods. This prejudicial disadvantage is apparently revealed in the relative costs of the two methods. The results obtained are summarised below (Tables 25 and 26):—

TABLE 25

YIELDS AND BLACK-POD INCIDENCE AT APONMU IN THE PERIOD APRIL 1952 TO  
FEBRUARY 1953

|                                                      |    |    |    |    |    | Spraying | Control Method<br>Inspection<br>and<br>Removal |
|------------------------------------------------------|----|----|----|----|----|----------|------------------------------------------------|
| Mean No. healthy pods per tree                       | .. | .. | .. | .. | .. | 12.6     | 5.0                                            |
| Mean No. black-pods per tree                         | .. | .. | .. | .. | .. | 0.8      | 9.6                                            |
| Mean No. total pods per tree                         | .. | .. | .. | .. | .. | 13.4     | 14.6                                           |
| No. black-pods expressed as percentage of total pods | .. | .. | .. | .. | .. | 6.2 %    | 65.6 %                                         |

The above results were obtained by actual counts of pods. The percentage of black-pods in a neighbouring area where no control measures were applied was estimated to be about 75 per cent, for the period April 1952 to February 1953.

Control measures were started in April and ended in December. Fungicide spray (1 per cent Carbide-Bordeaux mixture) was applied at intervals of three weeks throughout this period, comprising a total number of twelve applications given to 21,661 trees. Control by inspection of trees every other day for removal of infected pods in the earliest symptom stage, was started in April and ended in December, during this period 6,891 trees were treated.

The relative costs of the two control methods, as found in this trial at Aponmu, are summarised below.

TABLE 26  
COST OF BLACK-POD CONTROL

|                                          | <i>Spraying</i> | <i>Control Method<br/>Inspection<br/>and<br/>Removal</i> |
|------------------------------------------|-----------------|----------------------------------------------------------|
| No. trees treated .. .. .                | 21,661          | 6,891                                                    |
| Approximate acreage treated .. .. .      | 40              | 12                                                       |
| Total cost (pounds) .. .. .              | £700.9          | £246.4                                                   |
| Cost per tree (pence) .. .. .            | 7.8d            | 8.6d                                                     |
| Cost per fermented pod (pence) .. .. .   | 0.6d            | 1.7d                                                     |
| Cost per lb, dry cocoa (pence) .. .. .   | 7.1d            | 20.5d                                                    |
| Cost per ton, dry cocoa (pounds) .. .. . | £66.3           | £190.5                                                   |
| Cost per acre (pounds) .. .. .           | £17.1           | £21.5                                                    |

The above (Table 26) shows that control of black-pod by spraying was economic, in so far as the treatment cost per ton of cocoa (£66.3) is considerably less than its value (£170). Control by inspection of trees and removal of pods was not economic, because the cost of treatment per ton of cocoa (£190.5) was greater than its value (£170). The cost of this method is incurred through labour and supervision, as the cost of the implements used (harvesting knives) is relatively small and may be neglected. It follows that when black-pod incidence is relatively severe (say more than 10 per cent of the pods likely to be affected) the average number of pods per tree should not exceed eleven. Otherwise, the method should only be applied to trees averaging more than ten pods per tree, when the general level of black-pod incidence is likely to be less than 10 per cent. On the other hand, it is probable that spraying costs can be lowered through better use of the labour by employing more efficient equipment. Alternatively, a larger number of pods can be sprayed without greatly increasing the amount of time and materials per tree or per acre. It follows, therefore, that spraying will be economic in the case of relatively high-yielding trees. This result is to be expected because, in the Aponmu trial, the cost of labour and supervision (£357) represented more than half of the total spraying costs (£701).

It is hoped to lower the cost of spraying by reducing the number of applications. This possibility will be examined in 1953-54, when an area is to be sprayed at intervals of six weeks instead of three week intervals between applications.

It is desirable that the technique of spraying should be perfected by the Department of Agriculture, to determine how cheaply and effectively it can be done before it is recommended to farmers. In the meantime, farmers are being advised to attempt control of black-pod by regular inspection of trees and removal of infected pods. The advantages that can accrue from this method are being demonstrated in the cocoa observation plots which are maintained by the Cocoa Division. An illustrated pamphlet on control of black-pod disease has been produced and is being made available to farmers.

*Cotton.* (H.E. King) Bacterial blight (*Xanthomonas malvaccarum*) was more severe than in either of the two previous seasons. How much reduction in yield of cotton in Northern Nigeria can be attributed to this disease in its several manifestations (angular leaf spot, vein blight,



blackarm and bacterial boll rot) is not yet clear but it seems probable that it can in some seasons be responsible for much damage to bolls. At the same time differences between strains in the severity of symptoms displayed (in some cases related to known differences in genetic make up in terms of resistance gene) are not related obviously to differences in yield. "MU8A" a known susceptible type, fairly consistently outyields some strains of known high resistance. Seasonal variations in the magnitude of the advantage shown by one strain over another have not yet been sufficiently accurately determined but MU8A did in fact this season give a smaller increase over 26C than in previous trials.

The heavier incidence of the disease this season enabled clear differences to be detected by field observation between selections from Samaru 26C believed in previous seasons to be all satisfactorily resistant. One in particular, 4998-14, which had a good record for yield and other characters and which had been a contributor to the new mixture known as "Select Progeny Bulk" made up last season, was clearly not good enough under the more severe conditions. It stood out beyond doubt in some plots as susceptible to heavy leaf damage and elsewhere (including some of the district variety tests) it could be detected by careful examination as inferior in resistance.

The yields in replicated experiments of this strain, and of the "Select Progeny Bulk" of which it was a component, did not show any drop which could be attributed to bacterial blight but the "Select Progeny Bulk" in multiplication at Daudawa showed widespread symptoms and gave a most disappointing yield. It was considered best, therefore, to drop both the strain and the mixture, particularly as the previous season's bulking of "New Nucleus Stock" did so well this year that the "Select Progeny Bulk" had no strong claim to go forward as a replacement.

*Groundnut*.—Rosette Disease (virus) continued to be severe in late-planted fields, particularly at Mokwa.

*Guinea-Corn*. (*Sorghum*).—Covered smut (*Sphacelotheca sorghi*) was found in all areas of Northern Nigeria. Outstations are advised to treat seed with copper carbonate.

*Irish Potato Blight*—(*T. A. Russell*)—Potatoes are grown above 6,000 feet in the Bamenda highlands and have there become a staple food of the people. Two crops are planted, the first growing from April to July, the second from September to December. Reports were received that the first crop had been almost totally destroyed by a disease not hitherto known in this district but thought to be late blight; a visit was accordingly made at the time of the second crop. Although damage to the second planting was less severe than it had been in the earlier one, blight (*Phytophthora infestans*) was found in every plot of potatoes examined. It seems likely that climatic conditions during the first planting are particularly well suited to the fungus and that recurrent loss of crop is to be expected.

The cultivation practised in this area is so primitive and the people so impoverished that the application of the standard method of control by spraying is hardly practicable. Under rather similar climatic conditions in East Africa, however, some potato varieties have shown high resistance and even immunity to the strain of the fungus there prevailing. Assistance was therefore sought in obtaining blight-resistant potatoes for trial at Bamenda in the rainy season of 1953. Thanks are due to the Director, Scottish Plant-Breeding Station, the United States Department of Agriculture, and the Dominion Horticulturist, Canada for kindly supplying suitable varieties.

*Rice*.—A disease affecting the panicles of paddy caused by the fungus *Ephelis pallida* Pat., was recorded for the first time in Nigeria in a tidal swamp area at Isoba near Port Harcourt. The varieties Indo-China 70 and Kavunginpothala 12 were affected but the damage was slight.

*Sugar Cane*.—Red rot (*Colletotrichum falcatum*) has now been found in six Provinces in Northern Nigeria, namely:—Zaria, Kano, Katsina, Sokoto, Ilorin and Adamawa.

New Sugar Cane varieties are being introduced for testing in the North for possible resistance.

## ENTOMOLOGY SECTION

### STAFF

|                     |                                       |
|---------------------|---------------------------------------|
| J. R. G. Sutherland | <i>Senior Entomologist</i>            |
| J. T. Davey         | <i>Entomologist</i>                   |
| J. L. Gregory       | <i>Entomologist</i>                   |
| M. A. Choyce        | <i>Cotton Entomologist (E.C.G.C.)</i> |
| A. F. H. Baillie    | <i>Cotton Entomologist (E.C.G.C.)</i> |

The major problems investigated by the Entomology Section included locusts, a study of the control of beetles attacking yams in the Eastern Region, investigations on the control of major cacao pests in the Western Region, and a Nigerian survey of stem-borers and other pests of cereals.

Mr J. T. Davey continued his secondment to C.I.P.P.A.S. as leader of the mission in the French Sudan which is studying the African Migratory Locust, *Locusta Migratoria Migratorioides*.

### STUDIES OF THE ECOLOGY OF THE AFRICAN MIGRATORY LOCUST—J. T. DAVEY

The discovery of adults and larvae of locusts in the sahelian vegetational zone, outside the outbreak centre on the middle Niger, in the Autumn of 1950, was followed by the organisation of a mission in 1951, to study the significance of this discovery. The duration of the original mission was to have been about nine months but at the last meeting of C.I.P.P.A.S., it was decided to request the Government of Nigeria to allow the work to continue for a further eighteen months. This request was granted.

It was suspected that the presence of locusts in the sahelian vegetational zone was due to a large-scale movement of adults in the Autumn, from the Aire Gregarigene, with the return migration of a new generation produced in the sahelian zone in December or January. Obviously the only proof of such a movement was to be obtained by marking adults in the sahelian zone and trying to recapture them within the flood plains.

In the Autumn of 1951-52 a general survey was made of a large part of the sahelian zone. Locusts were not numerous and it was impossible to find enough material to make marking experiments worth while. Nevertheless, it was noticed that at the end of the year a decline in numbers occurred followed by a complete evacuation of the area. Some time later, adults similar to those seen in the sahelian zone, reappeared within the flood plains. There was, however, an inexplicable gap between the dates when locusts left the sahelian zone and when they reappeared in the flood plains, on the edges of the land then being uncovered by the retreating floods.

In the Autumn of 1952, the mission returned to the Farimake (the local name for that part of the sahelian zone adjoining the flood plains) to find a great increase in numbers compared with those seen the previous year. Marking experiments were started, using small hand sprayers and oil paints, but owing to the late arrival of the mission only 1,450 could be marked. At the end of the year, there was again a great decline in numbers resulting in the complete disappearance of the population. Immediately afterwards, the mission left the Farimake for the flood plains, and here, most unexpectedly, adults were found in numbers living on the grasses above the flood waters. These locusts appeared to be identical with those seen in the Farimake but statistical comparisons are not yet available. Later, as the floods receded, the locusts left the grasses above the water for the dry land then being uncovered, and here egg-laying took place. No marked locusts were recovered and so formal proof is as yet lacking, but all the accumulated evidence suggests that each autumn the bulk of the adults leave the flood plains for the sahelian vegetation zone and there produce a further generation which returns to the flood plains early in the new year. The success of this sahelian generation (which appears to be greatest in years of excessive rainfall) determines the numbers which return to the flood plains and, therefore, the possibility of the formation of hopper bands.

With the arrival of the adults in the flood plains, the mission settled at Dogo to continue ecological studies. In particular, different methods of assessing adult densities are being compared. It already appears that the numbers per 100 paces present a reliable estimate which may be converted into numbers per unit area. Other studies include the activity of larvae and adults in relation to the changing temperature throughout the day, and the distribution of adults and larvae in relation to the micro-climate of different habitats.

#### STUDIES OF THE BIOLOGY AND CONTROL OF BEETLES ATTACKING YAMS—J. L. GREGORY

Yam beetle experiments were carried out at Kwale. The "seed" yams received five treatments before planting (as shown in Table 27).

There was no significant difference between the total weights of yams harvested from plots subjected to the various treatments. However, the overall attack rate was only 2.4 per cent, so that this result is not unexpected. Table 27 shows the total attack rates per treatment over a 6 by 6 Latin Square, with fifty-five stands per plot.

TABLE 27  
YAM BEETLE ATTACK RATES: TREATMENT TOTALS

|                                   |       |
|-----------------------------------|-------|
| Agrocide 2 dust .. .. .           | 5     |
| 5 per cent D.D.T. dust .. .. .    | 9     |
| Agrocide wettable powder .. .. .  | 11    |
| D.D.T. wettable powder .. .. .    | 7     |
| Mulching with palm leaves .. .. . | 13    |
| Control (no treatment) .. .. .    | 13    |
|                                   | <hr/> |
|                                   | 48    |

The effect of treatment upon attack rate is significant ( $P < .05$ ), although with such a low rate of attack it would be unwise to give too much weight to this result. As in 1951-52, the only conclusion which can be drawn from the experiment is that the Agrocide formulations appear to be more effective in reducing the rate of yam beetle attack than do their D.D.T. counterparts or mulching.

Testing trials were carried out to determine whether any of the treatments caused a detectable off-flavour in the yams. There was no significant difference at the 5 per cent level between yams from treatment and control plots.

#### STUDIES OF THE BIOLOGY AND CONTROL OF SHOT-HOLE IN YOUNG COCOA PLANTS—

J. L. GREGORY

Up to the present time, the following species of Coleoptera have been collected from seedling cacao :—

##### Bostrychidae :

*Xyloperthodes discedens* Lesne

\**Xylopertha picea* Olivieri

*Micrapata neglecta* Lesne

##### Scolytidae :

*Xyleborus compactus* Eichhoff

*Hypothenemus ater* Eggers

\**Hypothenemus pusillus* Eggers

*Hypothenemus subvestitus* Eggers

*Stephanoderes theobromae* Eggers

*Stephanoderes polyphagus* Eggers

The species marked (\*) have been newly recorded during the current year. In addition to these, one other species of *Xyleborus* and at least two other species of the *Stephanoderes-Hypothenemus* group have been recorded, but not yet identified.



It has been very difficult, even by comparison with named specimens, to separate some of the Scolytids into their species and this has held the work up to a considerable extent. However, a working key to the species involved has been constructed and studies are proceeding on this basis, though the range of some of the "species" may be rather inexact.

Specimens are being sent to Dr D. E. Schedl of Austria, the authority on the African Scolytidae, for final authoritative identification. It is hoped that he will delimit the ranges of doubtful species.

Of the above list, *X. compactus*, *H. ater*, *H. pusillus*, *S. polyphagus* and *S. theobromae* are common but the remainder are only occasionally found attacking cacao.

*Xyleborus compactus* is the only beetle which has been observed attacking live seedlings and causing them to die back. It has been definitely recorded only on seedling cacao, though there are two rather doubtful records of it attacking cacao. It also attacks coffee seedlings and rooted cuttings, but again has not been seen on adult trees. So far these are the only two host records.

It has been recorded in the Western Region in the following localities: Ibadan, Elepo, Araromi, Ijebu Igbo (Production Board Project) and Odo Ona Nla and is probably distributed over most of the cacao-growing areas of Ibadan, Oyo and Ijebu Provinces. It has not yet been found in Ondo Province, but little work has been done in that area.

Attempts to breed the insect through from adult to adult have not yet succeeded, largely owing to the difficulty of feeding the larvae. Consequently, no figures on length of life history are available, except for the duration of the egg and pupal stages, which are approximately five and six to seven days respectively. Taking these figures as a basis, the normal length of the life cycle would be of the order of forty days.

The beetle bores into the seedling radially or tangentially until it reaches the pith, where it constructs a rounded brood chamber. The height at which *X. compactus* attacks the plant varies considerably, but it is commonly between  $2\frac{1}{2}$  inches and  $12\frac{1}{2}$  inches. The wood which is excavated is thrown out via the entrance hole. The course of events thereafter is not clear, but it would appear that the female cultivates a fungus upon which both larvae and adults feed.

Control experiments are being carried out at two sites, Elepo and Moor Plantation. In the first one-acre area, eleven insecticidal treatments are being compared with an untreated control. The appropriate insecticide is brushed onto the whole of the stem of the seedlings once a month. These treatments started in August 1952.

The second area is 0.44 acres in extent, and contains 120 plots in twelve blocks of ten treatments each, including control. The seedlings are planted at 4 feet by 4 feet. The various formulations are brushed on as at Elepo, at monthly intervals from early June. However, in this case the first block only was painted in June, the first and second in July, the first to third in August and so forth, in an attempt to obtain some indication of suitable timing and frequency of application on which to base further experimental work.

In no case have the treatment effects yet been statistically significant. This can be interpreted that the insecticides being used are probably not strong enough or persistent enough to impart a lethal dose to the adult beetles during the short time they are on the surface of the plant, nor are they sufficiently penetrant to enter the galleries within the plant.

Small scale trials in the laboratory have indicated that Dieldrin may be the best of the insecticides tested for the control of Scolytid borers on cacao, both in initial kill and in persistence. The effect of insecticides is dependent very much upon the time taken for the beetle to enter the seedling. If an insect alights on a cacao plant and bores in immediately,

the chances of its picking up a lethal dose of insecticide are considerably less than if it walks about over the surface for some time. Several observations have been made on the time taken for entrance, and it would appear that *H. ater* will remain on the outside of a healthy seedling until it dies, whereas *X. compactus* may enter in a few hours.

Sticky traps were set up in the experiment at Moor Plantation in an attempt to obtain information on the flight and numbers of Scolytids throughout the year. Up to the present date amongst the species attacking cacao only one *Hyleborus compactus* has been recovered from these traps, although several other unidentified species of Scolytids which have not been observed on cacao, have been taken.

So far in 1952-53 little damage by Scolytids has been seen and none reported by outside organisations.

The only area in which dead seedlings have been reported is the Cacao Establishment area at Araromi. Where the seedlings are dying rapidly, Scolytids were present, but very few in live wood. In a total of thirty dead or dying seedlings examined, two were attacked by *Hyleborus compactus*.

#### STUDIES OF THE BIOLOGY AND CONTROL OF CAPSID PESTS OF CACAO—J. R. G. SUTHERLAND

Observations were continued on the population trends of the three major Capsid pests of cacao, *Sahlbergella singularis*, *Distantiella theobroma* and *Helopeltis bergrothi* in five pairs of plots in the Western Region, ranging in size from one to ten acres. Dusting trials were carried out on these paired plots, and small scale comparisons of combined insecticidal and fungicidal spray formulations were undertaken at Odo Ona Nla (INA).

Throughout the year, populations of *D. theobroma* were negligible in the control plots, except at Owena where a "plateau" of between ten and twenty individuals per 100 trees was recorded on vegetation from March to July 1952. *H. bergrothi* population densities were generally low throughout the year, although small "peaks" occurred in most plots during May, June and July. This species is essentially a pod-feeder, causing only superficial damage, but at Ajue in Southern Ondo Province small numbers were observed feeding on vegetation in July.

Numbers of *S. singularis* began to increase in all plots in late June, and continued until population "peaks" were reached in September and October on pods, and in January and February on vegetation. An exception was Odo Ona Nla (INA), where the counts fluctuated more than those of any other plot, from May 1952 until March 1953.

Five treatments were given at 35-day intervals from the second half of August, using 5 per cent D.D.T. dust applied with modified Allman Midget portable motor-dusters. Weather conditions were uniformly good for the first series of applications, and correspondingly bad for the second. Thereafter, they were generally satisfactory. Despite the bad weather during the second series, all treatments resulted in a rapid reduction of capsid numbers, which was maintained for some thirty days at least.

Although the population "peaks" on vegetation were clearly evident in all control plots, those in treatment plots were suppressed to a marked degree, except at Owena, where the density was reduced to about forty individuals per 100 trees, which is marginal for blast effect.

Table 28 shows monthly moving averages of *S. singularis* and *D. theobroma* present in the various plots, together with similar averages of green pods present during the periods from July to September 1951 and 1952. These months were chosen for comparison on the assumption that the potential volume of the main cocoa crop is dependent largely upon the numbers of young pods which survive to a length of 2½ inches or more during this time. In reading this table, it should be noted that the treatment plots were chosen originally as being in the worse vegetative condition of each pair.

TABLE 28

COMPARISON OF CAPSID (*Sahlbergella* AND *Distantiella*) POPULATIONS (NUMBERS PER 100 TREES) AND GREEN POD COUNTS (NUMBERS PER 100 TREES) FOR TREATED AND UNTREATED PLOTS AT FOUR STATIONS AND EXPRESSED AS AVERAGES FOR THE PERIOD JULY TO SEPTEMBER, — IN 1951 AND 1952

| PERIODS .. .. .                          | July to Sept. 1951<br>(Pretreatment) |            | July to Sept. 1952<br>(After 6 treatments) |            |
|------------------------------------------|--------------------------------------|------------|--------------------------------------------|------------|
|                                          | Capsids                              | Green Pods | Capsids                                    | Green Pods |
| INA (Control 1952-1953) .. .. .          | —                                    | —          | 792                                        | 1,338      |
| INA (Treatment) .. .. .                  | 26                                   | 1,296      | 287                                        | 1,520      |
| INA (Control 1951) (Treatment 1952-1953) | 51                                   | 4,019      | 264                                        | 4,825      |
| Ilesha (Control) .. .. .                 | 189                                  | 4,271      | 101                                        | 1,997      |
| Ilesha (Treatment) .. .. .               | 334                                  | 3,768      | 51                                         | 3,306      |
| Ado Ekiti (Control) .. .. .              | 217                                  | 2,445      | 398                                        | 2,635      |
| Ado Ekiti (Treatment) .. .. .            | 152                                  | 3,728      | 86                                         | 2,234      |
| Ondo (Control) .. .. .                   | 212                                  | 1,046      | 345                                        | 2,125      |
| Ondo (Treatment) .. .. .                 | 290                                  | 1,237      | 189                                        | 2,272      |

All plots indicated in Table 28 have been under treatment for two main crop seasons. Comparing the 1951 and 1952 figures for *S. singularis* and *D. theobroma*, all treated plots show reductions of capsid numbers over those in the control plots in the latter year. In many instances, the green pod counts are improved over those of the paired plot and also over the previous year's record for the same plot. Ado-Ekiti and Ondo plots are being treated against black-pod disease by removing affected pods, thereby effecting a constant decrease in the numbers of larger green pods as the season progresses. However, data for the period, 1st July, 1951 to 31st December 1952, show that the total numbers of green pods differ significantly, in favour of the treated plots.

A randomised block spraying trial on 2 acres with seven replications was designed to test the effect of introducing small quantities of D.D.T. emulsion concentrate into Bordeaux mixture used at 35-day intervals for black-pod control, and to compare this formulation with D.D.T. alone and with a sticking agent. The results indicate that the insecticide plus fungicide combination may be about equally as effective insecticidally as the D.D.T. with or without the sticker; however these treatment effects are inconclusive at this stage.

#### SURVEY OF STEM BORERS OF GRAMINACEOUS CROPS—J. R. G. SUTHERLAND

The preliminary survey of stem-borers of cereal crops begun in 1951 was continued during the period September to December 1952. Six provinces lying within the Northern and Southern Guinea vegetation zones, the Bauchi Plateau, and Derived Savannah areas were visited. The provinces were Bauchi, Plateau, Benue, Niger, Kabba and Ilorin.

Guinea-corn and millet were the most heavily infested crops, the mean attack rate being only slightly less than that found in 1951 (Tables 29 and 30). However, the maximum infestation rates for these two crops were less than half those of the previous year, and the minimum much higher. Maize showed a much greater overall attack rate than in 1951, but in that year the number of samples examined was very small.



TABLE 29

PROVISIONAL PERCENTAGE RATES OF STEM-BORER ATTACK ON CROPS IN SIX PROVINCES OF NORTHERN REGION, 1952

| <i>Host Plants</i>                         | <i>No. of<br/>Samples</i> | <i>Minimum<br/>Rate<br/>per cent</i> | <i>Maximum<br/>Rate<br/>per cent</i> | <i>Mean<br/>Rate<br/>per cent</i> |
|--------------------------------------------|---------------------------|--------------------------------------|--------------------------------------|-----------------------------------|
| Guinea-Corn .. .. .                        | 76                        | 23.4                                 | 32.5                                 | 28.6                              |
| Millet .. .. .                             | 34                        | 19.5                                 | 28.7                                 | 27.6                              |
| Maize .. .. .                              | 16                        | 23.5                                 | 28.0                                 | 24.1                              |
| Rice .. .. .                               | 45                        | 19.1                                 | 22.5                                 | 21.7                              |
| Sugar Cane .. .. .                         | 19                        | 9.0                                  | 28.5                                 | 22.0                              |
| Acha ( <i>Digitaria exilis</i> ) .. .. .   | 5                         | 0.0                                  | 0.0                                  | 0.0                               |
| Aburu ( <i>Digitaria iburua</i> ) .. .. .  | 3                         | 7.0                                  | 18.0                                 | 14.3                              |
| Tamba ( <i>Eleusine coracana</i> ) .. .. . | 2                         | 4.0                                  | 19.0                                 | 11.5                              |

Studies of the taxonomy of the borers collected have become unexpectedly complicated, owing largely to the recent revision of the genus *Sesamia*, and to difficulties of identifying larval and pupal forms. Many identifications are incomplete or lacking. Therefore, in Table 31 the borers are indicated by genus only, unidentified specimens and single plants with empty galleries being shown under "Undetermined Genera".

TABLE 30

PROVISIONAL PERCENTAGE RATES OF STEM-BORER ATTACK ON CROPS IN EIGHT PROVINCES OF NORTHERN REGION, 1951

| <i>Crop</i>                              | <i>No. of<br/>Samples</i> | <i>Minimum<br/>Rate<br/>per cent</i> | <i>Maximum<br/>Rate<br/>per cent</i> | <i>Mean<br/>Rate<br/>per cent</i> |
|------------------------------------------|---------------------------|--------------------------------------|--------------------------------------|-----------------------------------|
| Guinea-Corn .. .. .                      | 63                        | 2                                    | 78                                   | 32.87                             |
| Maize .. .. .                            | 4                         | 6                                    | 25                                   | 13.25                             |
| Rice .. .. .                             | 11                        | 8                                    | 31                                   | 16.45                             |
| Millet ( <i>Pennisetum sp.</i> ) .. .. . | 76                        | 5                                    | 04                                   | 31.22                             |

TABLE 31  
PRELIMINARY SURVEY OF STEM-BORERS OF GRAMINEAE BY VEGETATIONAL ZONES, GENERA, HOST PLANTS  
AND NUMBERS OF BORERS, PER 100 PLANTS FOR EACH LOCALITY IN 1952

| Host Plants | ZONES             |    |    |    |    |    |     |       |                   |    |     |    |    |    |     |       |
|-------------|-------------------|----|----|----|----|----|-----|-------|-------------------|----|-----|----|----|----|-----|-------|
|             | Northern Guinea   |    |    |    |    |    |     |       | Southern Guinea   |    |     |    |    |    |     |       |
|             | No. of Localities | P  | B  | S  | E  | Rh | O   | Total | No. of Localities | P  | B   | S  | E  | Rh | O   | Total |
| Guinea-corn | 14                | 11 | 62 | 21 | 8  | —  | 261 | 363   | 39                | 22 | 105 | 84 | 66 | —  | 833 | 1,110 |
| Millet      | 7                 | 17 | 7  | 1  | 24 | —  | 147 | 196   | 19                | 28 | 19  | 25 | 37 | —  | 436 | 545   |
| Maize       | 2                 | 1  | —  | 22 | —  | —  | 33  | 56    | 3                 | —  | 10  | 15 | 7  | —  | 40  | 72    |
| Rice        | 5                 | —  | —  | —  | —  | —  | 104 | 104   | 32                | 1  | —   | 1  | 2  | —  | 715 | 719   |
| Sugar Cane  | 2                 | —  | —  | —  | —  | —  | 57  | 57    | 12                | 1  | —   | 1  | —  | —  | 276 | 277   |
| Acha (i)    | 1                 | —  | —  | —  | —  | —  | —   | —     | 1                 | —  | —   | —  | —  | —  | —   | —     |
| Aburu (ii)  | 1                 | —  | —  | —  | —  | —  | 7   | 7     | 2                 | 4  | —   | —  | —  | —  | 32  | 36    |
| Tamba (iii) | —                 | —  | —  | —  | —  | —  | —   | —     | 1                 | —  | 2   | 4  | —  | —  | 13  | 19    |

*P* = *Proceras* spp.  
*S* = *Sesamia* spp.  
*Rh* = *Rhinaphe* spp.

- (i) = *Digitaria exilis*
- (ii) = *Digitaria iburua*
- (iii) = *Eleusine coracana*

[illegible]

B = *Busseola* spp.  
E = *Eldana* spp.  
O = Undetermined

*Busseola fusca* was the species most frequently collected in the Northern Guinea Zone. It was nearly equalled in the Southern Guinea Zone and was surpassed in the Derived Savannah areas by *Sesamia spp.* In contrast to the 1951 records *Proceras spp.* occurred about as frequently in guinea-corn as in millet. They were reported from maize for the first time in the Derived Savannah. In the Southern Guinea Zone, records were also taken for the first time on rice, sugar cane and aburu (*Digitaria iburua*) and in the Derived Savannah on rice.

*Eldana saccharina* was recorded on millet in all four zones, but *Rhinaphe spp.* were not collected, although in 1951 there had been some infestation of rice by this species.

No work has yet been carried out on the relationship between attack rates of various borer species and the differential effects upon numerous plant host species. However, it is reasonable to conclude from the results of two years' investigation that considerable losses occur annually from stem-borer infestations. A conservative estimate, based upon average yearly production figures of the main cereal crops, on current prices and on a factor of 0.5 per cent loss of yield for each 10 per cent attack rate, would place these annual losses to Nigeria at about £700,000.

The first step toward improvement of the situation is crop sanitation, the second is the introduction of resistant varieties.

#### TRIALS OF CHEMICAL CONTROL OF STEM BORERS ATTACKING MAIZE—J. R. G. SUTHERLAND

High infestation rates of stem-borers in maize, often accompanied by considerable reduction in yield, are of frequent occurrence throughout Nigeria. Experience in South Africa and the United States has shown that the most economical and effective method of control of the borer species, is good crop sanitation, although it may sometimes be necessary to supplement cultural with chemical measures.

For various reasons, good clean-up procedures are unlikely to be satisfactorily applied to cereal cultivation in many parts of Nigeria, because they depend on full co-operation of all growers over a large area, and involve destroying crop debris.

A non-statistical maize borer control trial was set up at Moor Plantation in 1951, using 3.3 per cent D.D.T. wettable powder. This was applied from beer bottles to the funnels of knee-high maize plants. There was an increase in yield in the treated plot of 18 per cent over the control. Accordingly, a randomised block experiment was laid down for the early crop of 1952, to test five insecticidal treatments. The overall infestation rate was very low (5.03 per cent) and there was no significant difference between either yields or attack rates over the various treatments.

Another randomised block trial was set up for the late crop of 1952, on a total area of 2.25 acres. Lagos White Maize was planted at 15-day intervals from 15th August, 1952 on two-row sub-plots. The liquid concentrates were diluted as shown in Table 32.

TABLE 32

TABLE SHOWING APPLICATION RATES OF INSECTICIDES USED TO TREAT LATE PLANTED MAIZE IN 1952

| <i>Treatments</i>                                   | <i>Dilution Rate<br/>per gallon</i> | <i>Gallons per acre<br/>of dilute solution</i> | <i>Actual Toxicant<br/>per acre</i> |
|-----------------------------------------------------|-------------------------------------|------------------------------------------------|-------------------------------------|
| Diieldrin 18.5 per cent .. ..                       | 6.3 cc.                             | 28.0                                           | 32.6 gm.                            |
| Aldrin 23 per cent .. ..                            | 16.7 cc.                            | 27.5                                           | 105.4 gm.                           |
| "269", 18.5 per cent .. ..                          | 8.3 cc.                             | 28.0                                           | 43.0 gm.                            |
| Liquid Agrocide 3 (gamma B.H.C. 3.0 per cent) .. .. | 14.2 cc.                            | 27.0                                           | 11.5 gm.                            |
| Arkotine Miscible (D.D.T. 18 per cent) .. ..        | 15.2 cc.                            | 28.5                                           | 78.0 gm.                            |
| Control .. ..                                       | —                                   | —                                              | —                                   |

Table 33 shows the effects of insecticide treatment on yield. Table 34 shows the effects of different planting dates on yields. In both cases the differences are significant ( $P < .05$ ).



TABLE 33

TABLE SHOWING EFFECT OF INSECTICIDE TREATMENTS ON YIELDS OF LATE PLANTED MAIZE IN 1952 (POUNDS OF DRY GRAIN PER ACRE)

| Treatments |    |    |    |    | Total yield (lb dry<br>grain per acre) | Difference | Percentage<br>Difference |
|------------|----|----|----|----|----------------------------------------|------------|--------------------------|
| Control    | .. | .. | .. | .. | 435                                    | —          | —                        |
| D.D.T.     | .. | .. | .. | .. | 467                                    | 32         | 7.36                     |
| B.H.C.     | .. | .. | .. | .. | 515                                    | 80         | 18.39                    |
| Dieldrin   | .. | .. | .. | .. | 528                                    | 93         | 21.38                    |
| Aldrin     | .. | .. | .. | .. | 567                                    | 133        | 30.57                    |
| 269        | .. | .. | .. | .. | 591                                    | 157        | 36.09                    |

TABLE 34

TABLE SHOWING EFFECT OF DIFFERENT PLANTING DATES ON YIELDS OF LATE PLANTED MAIZE IN 1952 (POUNDS OF DRY GRAIN PER ACRE)

| Planting Dates |    |    |    |    | Total Yield (lb dry<br>grain per acre) | Difference | Percentage<br>Difference |
|----------------|----|----|----|----|----------------------------------------|------------|--------------------------|
| 15th August    | .. | .. | .. | .. | 325                                    | —          | —                        |
| 30th August    | .. | .. | .. | .. | 410                                    | 85         | 26.15                    |
| 15th September | .. | .. | .. | .. | 430                                    | 105        | 32.91                    |

The field used in this experiment was of low fertility and no manure was applied to the crop. The percentage differences between yields with the various treatments probably mean much less in terms of weight than if the insecticides had been applied to a high-yielding maize variety under good fertility conditions. It is interesting to note that each planting date after 15th August gave a progressive increase in yield, independent of any effect of the insecticides.

The insecticides under trial were provided gratis by their respective manufacturers and for those of United States origin no prices are available. However, the cost of treatment on a non-experimental basis with either Arkotine miscible or Agrocide has been calculated at about £1 per acre, including labour.

#### A SURVEY OF THE DISTRIBUTION IN NIGERIA OF THE SORGHUM MIDGE—

J. R. G. SUTHERLAND

In 1951, the Sorghum midge (*Contarinia sorghicola* Coq.) was reported from the Northern Territories of the Gold Coast. It had not been recorded in Nigeria, but during a visit to Ibadan in February 1953, Mr Rhind collected partially blind seedheads of volunteer guinea-corn which he suspected of being infested with this insect. There were no emergencies from this collection but a similar panicle taken nearby a few days later yielded seventy-five Cecidomyid flies. There were twenty-eight mature seeds and 614 blind flowers, many but not all of which showed evidence of insect emergencies.

A survey of blindness in volunteer sorghums and related wild grasses was undertaken, and by the end of March, specimens of these flies, determined by Dr H. F. Barnes as *Contarinia sorghicola* Coq., had been collected from a number of points within the area bounded by Iseyin-Ibadan-Epe, Ikeja and Abeokuta. The wild hosts involved were: *Sorghum guineense*, *S. arundinaceum* and *Panicum maximum*.

#### CHECK-LIST OF NIGERIAN INSECTS—J. L. GREGORY AND J. R. G. SUTHERLAND

Work continued on a check-list of insects of potential agricultural importance in Nigeria. An interim list of insect pests of major importance in the Territory was sent to the F.A.O. World Reporting Service for Plant Diseases and Pests.

## NEW PESTS RECORDED

During the period covered by this report, there have been sixty-nine new records of insects having actual or potential pest status within Nigeria. Some of these are species new to Nigeria, others are newly recorded from the economic plants involved.

The following pests may prove to be of importance :—

On *Citrus* : ? *Tragocephala* sp. on bark of shoots.

On *Guinea-corn* : *Contarinia sorghicola* on seed heads.

On *Kola* : *Cylas puncticallis* and *Dermestes maculatus* on nuts.

On *Oil Palm* : ? *Parasa* sp. on leaflets.

On *Rice* : *Gonocephalum simplex*

*Melanitis leda* and

*Trichispa sericea* on leaves ;

*Syllepte balteata* in stems.

## INVESTIGATION ON COTTON PESTS IN NORTHERN NIGERIA—M. A. CHOYCE

Routine records on the incidence of pests and the causes of crop loss were continued on standard observation plots at Daudawa, Gusau, Kontagora and Yola. At Gombe similar records were taken for the first time. At Samaru, observations were made on the Botanist's rotation plots as in previous years. These records reveal that Red Bollworm populations were lower than those reported last year, except at Kontagora and Yola. Pink Bollworm attack was notably higher than elsewhere at Yola and Gombe.

Studies on the pupal periods of the Red Bollworm, and on the emergence and diapause of the Pink Bollworm, are being continued. Emergences from Red Bollworms set during the 1951-52 season were disappointing, and no firm conclusions can be drawn from them. Records of Pink Bollworm population and emergence confirm the findings given in the 1950-51 Progress Report.

Numerous samples of seed cotton and cotton seed from the ginneries in the Northern Region were examined, and these again revealed a predominantly low infestation of Pink Bollworm.

Two insecticide trials were held during the season. At Samaru, good control of the mirid *Campylomma* was achieved, together with a marked reduction in leaf tattering. The precise effect on yield was obscured by the wide variation in fertility between the plots in the experimental area. At Daudawa the best insecticide treatment resulted in an increase of 50 per cent in the yield of clean seed cotton, compared with the control.

Applications of the equivalent of 4 lb D.D.T. per acre were given as dust (10 per cent D.D.T. and 3 per cent B.H.C.) and as an emulsion 1 per cent D.D.T.). There was an additional treatment of 1 per cent Toxaphene emulsion applied at the rate of 40 gallons per acre.

Each treatment was applied three times : on 24th October, 14th November, and 5th December, 1952. All treatments gave highly significant increases in yield compared with the control. There was no significant difference between the dust and the D.D.T. emulsion, but the latter was more effective than the Toxaphene emulsion. The greatest reduction in Red Bollworm (*Diparopsis* sp.) incidence was associated with the dust treatment. In another experiment, early spraying with 0.5 per cent D.D.T. emulsion at 40 gallons per acre (2 lb D.D.T. per acre) applied on 8th September, 22nd September, and 6th October, 1952, was associated with a reduction in mirid (*Campylomma* sp.) population, followed by an appreciable decrease in tattering damage to cotton plants.

Full details of the results from the seasons work have been published in the Empire Cotton Corporation's "Progress Report from Experiment Stations, Season, 1952-53".



## MAIZE RUST RESEARCH UNIT

### STAFF

Dr W. R. Stanton  
R. H. Cammack

Senior Scientific Officer  
Scientific Officer

### BREEDING WORK

Further tests have confirmed previous observations that the source of a high order of resistance of maize to rust, *Puccinia polysora*, is confined to Central America and the Caribbean area. Observations have been made on yield and a range of other characters, apart from rust, on a total of over a hundred imported maize varieties.

F<sup>1</sup> hybrids between two U.S.A. varieties (White Tuxpan, American Bounty) which have been selected under Nigerian conditions for four generations and resistant selections of material received from the Rockefeller Institute, Mexico (Rocamex Lines) are now undergoing primary yield tests. In the presence of rust, although partially susceptible, the aforementioned American varieties have shown yields of double those of local varieties.

Preliminary yield trials are being conducted on fifty second generation inbred lines for use in the production of hybrids and synthetics.

### PATHOLOGY

*Intensity and spread of rust.*—Owing to early onset of the rains in Nigeria and Gold Coast in 1953 much of the maize in the forest country has escaped severe attack. However, where planting was done at the normal time, the rust has developed as in previous years, *viz.*, at tasselling time.

*Viability of uredospores.*—The uredospores of *Puccinia polysora* are relatively short lived. Under optimum conditions, they become inviable after forty days. Low temperatures (less than 10° Centigrade) are rapidly lethal. This is in marked contrast to the viability of uredospores of temperate zone cereal rusts.

*Infection.*—This may occur on the first true leaf of a seedling, but in the field it does not normally take place until the leaf is comparatively mature. Spore production is heaviest on the leaf sheath where the pustules, though scattered, may be very large (0.5 to 1 cm. long).

Experiments are in progress to determine the peak period of infection and the effect of spacing and humidity on intensity.

From test plots widely scattered over southern Nigerian and the Gold Coast, no evidence has yet appeared of physiological forms of the rust. The identity of twelve other fungi pathogenic on Nigerian maize has been confirmed. A number of others await identification. Five seed-borne pathogens have been identified.

*Entomology.*—In conjunction with the Senior Entomologist, breeding lines are being assessed for stem-borer susceptibility. These pests are commoner on second season maize where their effect may be as serious as that of the rust. A more detailed account of the Unit's work will be published in a separate annual Report.

### PUBLICATIONS

RUSSELL, T. A.

The Vigour of some Cacao Hybrids  
Tropical Agriculture 29 : 3-7, 1952

THOROLD, C. A.

Airborne Dispersal of *Phytophthora palmivora* causing Black-Pod Disease of *Theobroma cacao*  
Nature 170 : 718, 1952

VINE, H.

Experiments on the Maintenance of Soil Fertility at Ibadan, Nigeria, 1922-51  
Empire Journal of Experimental Agriculture 21 : 65-85, 1953

VINE, H.

Notes on the Main Types of Nigerian Soils, Department of Agriculture, Nigeria, Special Bulletin No. 5, 1953 Federal Government Printer, Lagos





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British Empire Forestry Conference, 1947, 4s.

### Geological Survey Bulletins

- No. 6—The Nigerian Coalfield (Section 1 Enugu Area), *Bain*, 5s.
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The Geology of Mama, Nassarawa, *Raeburn* ;  
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